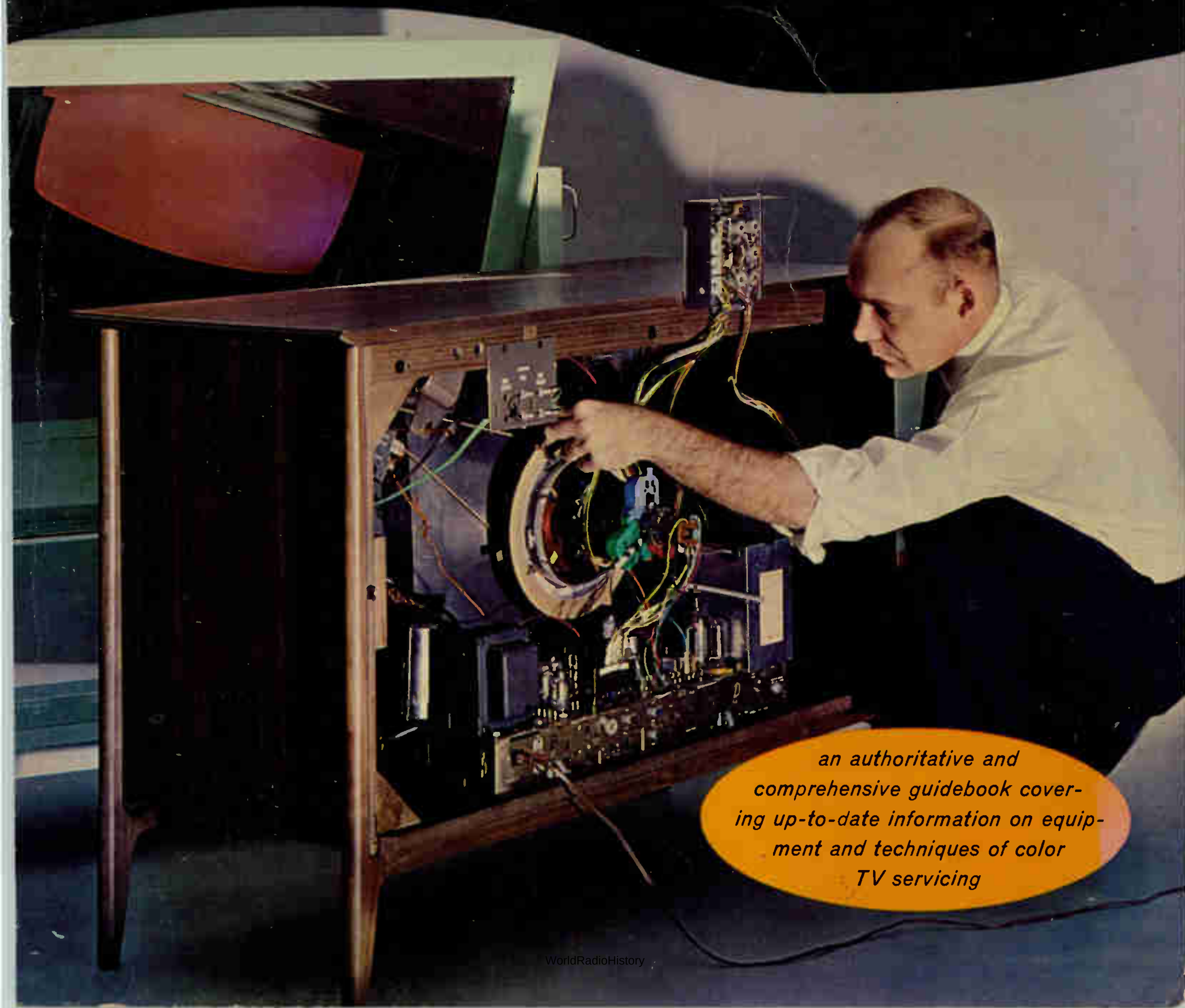
A Howard W. Sams PHOTOFACT PUBLICATION

ISSUE NO. 1 / $1.00

COLOR TV GUIDEBOOK



an authoritative and comprehensive guidebook covering up-to-date information on equipment and techniques of color TV servicing

INTRODUCING

Jerrold COLORAXIAL™ Program

COAX IS A MUST FOR COLOR TV

THIS

NOT THIS

Commercial installations have proved that coaxial downlead is *essential* for predictable, consistently good color TV pictures. Coax loss doesn't increase in wet weather, while twinlead loss goes up as much as six times. Coaxial cable can be run anyplace, even next to metal, without mismatch. Coax doesn't deteriorate with age. It won't pick up ignition noises or other interferences. In a word, for satisfactory color reception, even in "ideal" reception areas, your customers need coax.

And now, new Jerrold COLORAXIAL antennas and kits give you a perfect home-installation package for every color-reception need. With COLORAXIAL, you can offer the whole system, from coaxial antenna to indoor matching transformer, or adapt an existing 300-ohm antenna for coax operation. Listed below are all the COLORAXIAL components packaged individually and in kits, for easy, low-cost conversion. Ask your Jerrold distributor for COLORAXIAL brochure, or write *Jerrold Electronics, Distributor Sales Division, Philadelphia, Pa. 19132.*

CAX-16 • COLORAXIAL COLORGUARD

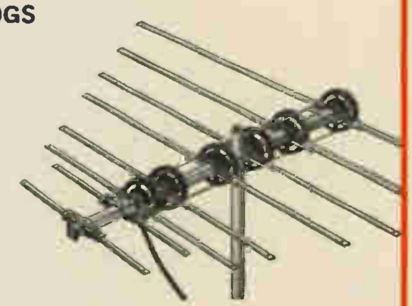
COLORAXIAL Antenna for metropolitan and suburban reception areas. Prematched to 75-ohm coaxial cable; complete with fitting. No outdoor matching transformer required—only an indoor Model T378. List $11.95

K-CAX-16 • COLORAXIAL Antenna Kit. Everything you need for complete installation—a CAX-16 Antenna, antenna tri-mount with 5-ft mast, 50 feet of coax cable with fittings, and T378 indoor matching transformer. List $29.95

COLORAXIAL PARALOGS

PAX-40 • COLORAXIAL Antenna for difficult suburban areas. Prematched to 75-ohm coaxial cable; complete with fitting. No outdoor matching transformer required — only an indoor Model T378 needed. List $22.95

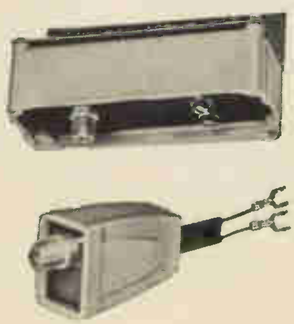
PAX-60 • COLORAXIAL Antenna for suburban to semi-fringe areas. Prematched to 75-ohm coaxial cable; complete with fitting. No outdoor matching transformer required—only an indoor Model T378 needed. List $32.95



CAT-2 • COLORAXIAL MATCHING TRANSFORMER KIT

One TO-374A mast-mounting matching transformer for any 300-ohm antenna, and one T378 set-mounting matching transformer, complete with bracket and mounting strap. List $8.20

COLORAXIAL matching transformers are also available individually: TO-374A, list $4.95; T378, list $3.25



COLORAXIAL CABLE

CAB-50 • 50 feet of sweep-tested RG-59/U 75-ohm coaxial cable complete with F-59A fittings attached, plus weatherboot. List $9.50

CAB-75 • 75 feet of sweep-tested RG-59/U 75-ohm coaxial cable complete with F-59A fittings attached, plus weatherboot. List $11.50

JERROLD ELECTRONICS

A subsidiary of The Jerrold Corporation

Circle 1 on literature card

who else but TARZIAN

fixes TUNERS *for only* $9.50

■ And, who else but the world's largest manufacturer of TV and FM tuners is as well-equipped, well-qualified and has available ALL necessary specifications required to provide unexcelled service on all makes and models?

Sarkes Tarzian, Inc. maintains Tuner Service Centers—completely-equipped and conveniently-located—to offer fast, dependable tuner repair service to any part of the country.

Cost, including ALL labor and parts (except tubes) is only $9.50 and $15 for UV combinations . . . with a 12-month warranty against defective workmanship and parts failure due to normal usage. No additional charges. No hidden costs. You do pay shipping.

Tarzian Service Centers are staffed by well-trained technicians and are assisted by engineering personnel to assure you of FAST, DEPENDABLE repair service. Every channel—not just the channels existing in any given area—is checked and re-aligned per manufacturer's specifications. Tarzian's exclusive cleaning method makes the tuner look—as well as operate—like new. In most instances, tuners received one day will be completely overhauled and shipped out the next.

Replacements on tuners beyond practical repair are available at low factory cost.

When inquiring about service on other than Tarzian-made tuners, always send TV make, chassis and Model number. Check with your local distributor for Sarkes Tarzian replacement tuners, parts, or repair service. Or, use the address nearest you for fast, factory repair service.

SARKES TARZIAN

TUNER SERVICE DIVISION — BLOOMINGTON, INDIANA

537 South Walnut Street
Bloomington, Indiana
Tel: 332-6055

10654 Magnolia Blvd.
North Hollywood, Calif.
Tel: 769-2720

Manufacturers of Tuners • Semiconductors • Air Trimmers • FM Radios • AM-FM Radios • Audio Tape • Broadcast Equipment

COLOR TV GUIDEBOOK

A HOWARD W. SAMS PUBLICATION prepared by a special staff of PF REPORTER

Color TV Guidebook

CONTENTS

Cat. No. PFR-1

TV Networks View Color

. . . plus a word from a nonaffiliate.

What the future holds in programing—as told by television's leaders.

Projections for 1965 place the accumulation of color receivers at 7% of the total sets viewed by Americans. Those sets would be of little use if it weren't for the stations that carry and originate color shows, the networks that produce color programs, and the advertisers who foot the bill for color productions.

Initially, only NBC carried any significant amount of color programming. Subsequently, ABC has begun color telecasting on a regular basis, accompanied by a strong increase in hours of color by NBC. There hasn't been too much activity so far by CBS, except for some carefully chosen, high-interest spectaculars.

We asked the heads of the three networks for some of their plans for the future of color TV. Following are the answers we received.

ABC Television Network—Thomas W. Moore, president, responded: A guiding principle of the ABC Television Network, in its effort to establish a vigorous and competitive network service for the American viewing audience, is a constant search for new ideas in programming and technology.

ABC Television started broadcasting color over its five owned TV stations September 1962 because we wanted to train personnel and gain experience in colorcasting. Also, broadcasting color was another opportunity for ABC-TV to increase the range of its service for its television audience.

In addition, we wanted to watch the barometer of public and advertiser acceptance. The public will cue us when to increase our colorcasting—they will let us know not only by the eagerness with which they buy color sets, but by their demands for color direct to us and through our affiliates. And we are confident that advertisers, too, will respond to the public's demands.

The network is replacing its equipment for film telecasting, as replacement becomes necessary, with new equipment that can be used for colorcasting as well as black and white. ABC's five owned television stations, in New York, Chicago (WBKB), Los Angeles, San Francisco, and Detroit are equipped to and do transmit programs in color, as do those affiliates which have installed the necessary technical equipment.

Leonard H. Goldenson, President of American Broadcasting - Paramount Theatres, Inc., has announced that we plan to build, possibly early next year, a large live-color studio in New York. ABC also intends to start the construction of a color studio on the West Coast. In addition, we will build studios for live color commercials. At present, we are set up to carry color film, and when we have these two new color studios ready, we will be equipped to carry as many live color programs as we feel necessary for our television schedule.

CBS Television Network—James T. Aubrey, Jr., former pres., referred us to William B. Lodge, vice pres. of affiliate relations and engineering, and some remarks he made to their Affiliates' Advisory Board meeting in November 1964: The percentage of U.S. homes with color receivers still is small; viewing habits in color homes still don't greatly affect program ratings; and advertisers still show little interest in paying anything extra for color. And, most black-and-white receivers still provide better reception than color sets for programs broadcast in black-and-white.

But, color television is making progress. The price of color sets gradually is coming down in terms of dollars—though not in comparison to the price of black-and-white receivers. Sears now lists a 16" rectangular color set, made in Japan, at $349.95, and a number of American-made 21" sets carry list prices ranging upward from $380.00—with some of these being discounted down to $350.00 or less.

At present, the manufacturer of color receivers has no practical alternative to the inherently expensive three - gun, shadow - mask picture tube. But Sony, at its Tokyo laboratory, is working on the single-gun, Lawrence tube which produces a much brighter picture and which may provide a major breakthrough in the cost of color receivers. If the Sony engineers do as well on this color tube as they did on portable small - screen television receivers, they could conceivably speed up the swing to color.

Having, I hope, assured you that we have an accurate picture of the growth rate of color - equipped homes, I realize that you still want to know what your Network plans to do in the way of color programming. The answer is that we still don't feel justified in shifting a large part of our program schedule into color. We will have color shows here and there in our schedule, but I don't want to imply that we intend to make a major expansion in color during 1965.

We will probably make a million-dollar installation of color cameras in one of our midtown theater studios within the next year—more because the lead time for such an installation is very long than because we think there is much risk of being hurt competitively if we don't add the color equipment.

Our basic position with regard to color still boils down to three sentences: Despite a natural reaction to jump on the color bandwagon for fear of being left behind, we think that a flexible, conservative approach is the wisest for us and for you. We don't intend to get caught at the starting gate when color becomes a significant factor. And, we are willing to go all out on color whenever this seems necessary.

If you visit our new Broadcast Center next time you are in New York, you won't doubt our willingness to plow back large sums of money into our business when we think the outlay is necessary.

NBC Television Network — Robert E. Kintner, president, asked Walter D. Scott, executive vice president, to respond to our request: In January 1965, NBC reported there were 2,860,000 color television sets in circulation—a 77% increase over the previous year—and predicted there would be 5,000,000 color receivers in use by the end of 1965.

The rising interest of the viewing public in color is the most persuasive evidence that the new medium is coming of age. It caps the growing importance of color in local-station schedules, the modest entry into color by our two rival networks, and the use of color commercials by more and more advertisers.

Color's rapidly ascending stature is a most gratifying development in the eyes of NBC, our affiliates, and independent broadcasters who have been pioneers in its growth. By grasping the potential of color and spreading it across their program schedules, they have established new dimensions of service and profit for the entire broadcasting industry.

The ramifications of color television's dynamic growth are tremendous, and they have just begun to be felt. Color is becoming a mass medium. As it continues to grow, we can only guess at some of the results, but others are readily apparent.

In the immediate future we will see an expanding number of advertisers using color commercials in a growing variety of ways—to exploit their added sales impact and to benefit from the larger audiences color programs attract. Color will continue to stimulate fresh program ideas and better programming. As color circulation mounts, the rating advantage of color programming will become increasingly evident — a matter of substantial significance in the light of the intense competition for audiences.

Advertiser, viewer, and station interest will draw the other networks into deeper involvement with color. This competition in itself will be healthy for the industry as a whole, will provide viewers and advertisers alike with a more complete service, will raise viewing levels and ultimately, increase broadcasting revenues. Even the most cautious wait-and-see broadcaster will soon realize that he must go into color.

NBC has broadcast more than 11,000 color hours since color was first introduced. During the same period CBS has programmed approximately 270 hours— only 10 of them in the last 2 years. ABC has broadcast about 350 hours.

We have led the way in color because we believe in it. We are confident that our advantage in experience, in equipment, in color-equipped affiliates, in development, and in quality will give us an important competitive edge as our medium moves steadily toward total conversion to color.

Unaffiliated Stations—Only a few stations that aren't associated with networks have pioneered in color programming. A leader among these is WGN in Chicago. Ward L. Quaal, executive vice president and general manager, sends us this word:

There are two schools of thought concerning the effect of color television sales. One is that as color grows, black-and-white set sales will decrease. The other is that new viewing habits and use of multiple television sets may hold monochrome sales fairly constant.

WGN - Television, without the benefit of network programming, presented 3011 hours of color to midwestern viewers in 1964, showing our faith in the broad acceptance of color. In 1964, 60 different advertisers presented their commercials in color on the station, showing their belief in the color breakthrough.

There are now an estimated 225,000 color sets in operation in Chicago, national leader in color programming, and over 3,000,000 color-television-equipped homes in the country. I predict the coverage area of WGN-Television alone will contain more than 3,000,000 color sets by 1975. New purchases of black-and-white will become virtually nil by that time. ▲

MANUFACTURERS SPEAK OUT On Color

The expectations of those who make chroma sets.

From the early days of color TV, set makers have been in and out of the business with disconcerting regularity. Now that consumers are showing a positive reaction, the picture has altered considerably. Many set builders are showing renewed interest in this multihued bonanza.

We queried 27 TV-set manufacturers, color and b-w, asking them for their present views and expectations regarding color-set sales and distribution. The following statements are from color-TV makers who responded. Some of the statements we received were quite lengthy. Where length was too great, or other subjects were covered, we've taken the liberty of condensing or excerpting.

Channel Master — Harold Harris, vice president, says: The dealer has a new toy (color TV) with which to attract new and old customers. He has a reason to be excited, to be enthusiastic, to advertise. He won't be spieling about a new model of last year's product; that is, he now has something that the buyer can recognize as fresh.

Since color TV is still mostly in the luxury class, the people buying color TV will also have the money to buy other items on display at the dealer's.

The servicing dealer can take best advantage of this fresh product by working with his distributor to get every bit of material and knowledge with which to go out and sell.

Electrohome — Robert Moore, vice president, marketing, has this to say: 1965 will be the emergence of the first all-Canadian color television chassis and it will be produced by Dominion Electrohome Industries Ltd., Kitchener, Ontario. There are a number of unique things about Electrohome's entrance into the color-television market. First, as we all know, there is presently no color telecasting in Canada; for a Canadian company to design, engineer, and manufacture a product of this type without a home market is therefore quite remarkable. Secondly, Electrohome—though small by comparison to the U.S. manufacturers—has engineered a completely different chassis from those presently found in the U.S. market.

For the past number of years Electrohome has achieved a reputation in the television field, especially in Canada, for its vertical chassis concept. The success of this "flip-down" vertical chassis approach has made Electrohome a dominant factor in the Canadian television market. This same concept and approach has been followed through with the color television chassis. Electrohome plans the introduction of its color television line the first part of June, 1965, though production is not expected to reach capacity until late August or early September.

Electrohome will be aiming at the middle and high end of the colored television market, therefore, all except one model will be in the 25"-tube category. This, coupled together with Electrohome's beautiful furniture designs, and the multitude of plus features that Electrohome will have to offer both in the performance of this chassis and demonstrable features, makes 1965 our most exciting year.

Emerson Radio — Chairman of the Board, Benjamin Abrams, comments: The rapid growth of interest on the part of consumers in color TV promises to make 1965 a banner year in sales. This company is projecting a 100% increase in color sales as compared to 1964 and this is expected to account for approximately 40% of our total dollar volume in sales. The substantial sales of color TV in 1964 was attained without in any way affecting the overall sales of black-and-white sets. It is expected that 1965 will be no different.

Hoffman Electronics Corp.—A. W. Bernsohn, Director of Public Relations, regrets that: Unfortunately, we have not yet finalized the resumption date for our color-TV activity, nor have we even decided for certain that it is to be in 1965.

Montgomery Ward — Mr. Gordon F. Farnsworth, national electronics merchandise manager, predicts: Montgomery Ward color-television sales will exceed the 50% increase rate expected for the color industry in 1965. We do not expect to see drastic price cuts in the industry, but because of the intense competitive situation at retail levels, we do feel that there will be some reduction in retail pricing and more low-priced leader items. This will result in a lower average price per set.

If price reductions are made in the general market, we will, as a matter of policy, reduce our prices to stay competitive. We will continue to keep pace with all future developments in tube sizes. For example, our new line will include sets with the new 25″ rectangular tube.

Wards will again offer a complete line of color sets both in catalogs and retail stores, ranging from the lowest-price metal-cabinet unit to three-way combination units selling in the $900 range.

Motorola, Inc.—S. R. Herkes, president of Motorola Consumer Products, Inc., wires: Color-television set sales have caught fire and are now in the category of mass-consumption products. Annual distributor-to-dealer color-receiver sales crashed through the million mark for the first time in 1964 when an estimated 1.3 million color sets were moved by the industry. I expect industry sales to climb into the area of 2 million sets in 1965. The changing shape of color receivers to the rectangular tube will continue to make news in 1965. Motorola introduced its 23″ rectangular picture tube color models late in 1963 (see July 1963 PF REPORTER, page 30) and sold more than 100,000 of these sets during 1964.

The remainder of the industry is now moving into rectangular color tubes and additional screen sizes are expected to become available this year. Motorola expects to sell between 200,000 and 250,000 rectangular-tube sets alone, this year. National Video Corp. is sole supplier of the Motorola-developed 23″ rectangular color CRT. Looking ahead, and informed of the increasing demand for this tube from other National Video customers, Motorola has decided to build its own color-tube manufacturing plant in Franklin Park, Ill. This plant will go into operation during 1966 as a second source of supply for the company.

Olympic Radio & Television Division, Lear Siegler, Inc. — Morris Sobin, president, in a speech before the New York Society of Junior Security Analysts, views the long-range outlook of color TV: One day during December 1965, some family will walk out of a neighborhood appliance store as the proud new owner of a color television receiver. This sale will elevate the color TV receiver industry into the elite ½-billion-dollar-a-year orbit, and this is really only the beginning. By next year, color set sales at retail should reach the billion-dollar-a-year rate and will probably surpass the dollar volume of black-and-white set sales.

The principal reasons for the current upsurge in color TV set sales are new lower prices, more and better color programs from independent stations as well as networks, and the constantly increasing performance and reliability of color receivers. Today, a color set is a status symbol among the more affluent members of our society. Five years from now this symbol will be near the top of the list of necessities for the young marrieds. Also, color TV is bringing the major TV set back into the living room where it can be admired by neighbors and friends with the low-priced black-and-white television continuing to be used in the den and bedroom.

Up to now, manufacturers of color sets have had as their primary target the job of reducing the material and labor content of the color set, so that the mass-market price category ($300-$400) could be reached. While competitive pressure has permitted the achievement of a receiver-price category low enough to attract a larger number of customers, this has been accomplished without any reduction in the major portion of cost—the color picture tube. As the industry color tube output is increased, competitive pressures in the normal course of events should bring the cost of tubes down.

During the past ten years only one picture tube size has been available for commercial production. This tube is the well known shadow mask round 21″ size. We have now entered a new phase of the broadening market by means of the "numbers game" of tube sizes. 23″ rectangulars came out in 1963. Late in 1964, rectangular 25″ version (see November 1964 PF REPORTER) became available, joined shortly after by a limited quantity of 19″ rectangular tubes.

The Japanese electronic industry is experimenting with the tube-size question and a Japanese color set with a rectangular 16″ tube is already being marketed in the United States. In addition, the Japanese are experimenting with even smaller color tubes in an effort to parallel the "tinyvision" success which they have had with small-screen black-and-white counterparts.

After the introduction of these various tube sizes has been digested, the normal process of consolidation and standardization will take place, so that by 1966 or 1967 at the latest, we could reasonably expect to see the 25″ tube as the standard for the larger color consoles and three-way combinations, while the 19″ or 16″ version will become the standard for the transportable color TV set.

It is thus reasonable to expect that as more and more color sets are sold, mass production techniques plus competitive pressures will continually clip away at the cost of the color set, so that a transportable-model leader price of under $200 is not unreasonable to expect by 1968.

However, for color to advance much past this point in terms of mass market appeal, we must probably await a technological breakthrough. This will most surely come by the time we reach the 1970's. Today's circuitry is rather complex, and the three-gun color tube in its present form is large and bulky. Many companies both large and small are industriously working to find this technological breakthrough, and I am sure some of you are already familiar with such terminology as the Lawrence Tube and the Apple Tube. Waiting in the wings is a flat tube which is now made in modest quantities by hand for certain special military applications.

In the next few years, circuit refinements will become evident, which will help further to reduce the cost of the color set within the framework of present technical knowledge. First we can expect to see a new series of receiving tubes which will operate at almost half the voltage required by the present types. These lower voltages will also allow the designer to use less costly associated components. The next logical step forward will be the introduction of transistors to replace vacuum tubes in many of the circuits within the set. By 1970, further design changes will provide for the introduction of micromodules or integrated circuits for many circuit applications. Each of these evolutionary changes will reduce the physical size of the receiver and will help to ultimately reduce the cost to the consumer.

Of the nation's 564 commercial television stations, more than 400 are equipped for some type of color broadcasting, with over 50 stations able to originate live local programs in color. Naturally, as greater emphasis is placed by the broadcasters on color transmission, the public will have an ever increasing incentive to buy color receivers. As soon as enough homes are equipped with color sets, advertisers will be willing to pay the premium to advertise their products in color and within the next few years will insist that their products be shown in color.

Each passing year sees an increasing number of color transmissions. Within five years most major television programs will be broadcast in color; black-and-white transmissions will be limited to repeat shows and old films. And finally, worldwide color programs—beamed via satellites such as Relay—will be commonplace, bringing into American homes the treasures of other continents in their natural colors.

Packard Bell — Wendell B. Sell, president, looks at color TV this way: The color television industry is no longer an "industry of the future." It is an industry of today—and one that will grow to unprecedented heights in the years to come.

For example, at the end of 1964 there were slightly over 2.7 million color TV sets in use. By the end of 1965 we will see approximately 5 million sets in use, a gain of very nearly 100%. Last year, Packard Bell increased sales of color TV sets very substantially over the previous year. We will do as well, or better, again this year.

Technically, the industry is developing some unique sets. For example, at Packard Bell we have eight years of color-TV experience behind us, being one of the two firms manufacturing color sets since its development, and we have just introduced the first truly mobile color TV made. It is our Tea Cart model and it can be rolled from room to room. This breakthrough in mobility is possible only because of another technical advancement—the development of our own system of automatic degaussing — Instant Color Purity. We also have the only batteryless remote control system for color, our exclusive Wireless Roto/Remote Control. All of these features help to make color TV a more attractive package to the consumer.

In the next six to eight years we at Packard Bell expect sales of color TV to continue dramatically increasing. Color TV is no longer a novelty. Our surveys show that it rates very high on every list of consumer wants. Additionaly, the public accepts the reliability of color sets and our records show that service calls on color sets are about the same in frequency as for black-and-white sets.

At the present, at least for 1965, I do not anticipate any significance drop in the price of color sets. However, there is no question that in the future prices will become lower because of increased production. And of course, as prices become lower, we will find an even broader segment of the market able to purchase color sets.

We also look forward to an increased market for color TV sales because more and more television programs are being televised in color. At present, NBC is the network leader in televising color. However, we can expect ABC and CBS to increase their color programming and it will be common to find all three major networks telecasting color at any given time. The independent stations are doing a tremendous job with color. It is now possible to see color shows almost around the clock on independent stations.

This has a spiraling effect: The more color televised, the more sets will be sold. The more sets that are sold, the more programs televised in color.

Philco Corp.—Armin E. Allen, general manager of consumer electronics operations, feels that: All the factors by which potential growth markets are normally judged strongly indicate that 1965 will be the first really big sales year for color TV—and the beginning of a new era of multimillion annual color-set sales. I believe that U.S. color television sales may reach two million domestically manufactured units in 1965, a gain of 700,000 units over 1964.

The main reason for this increase has been a significant change in the attitude of the consumer. In past years he has had to be shown. Now he is coming to the market place with a ready-made desire for color TV. He sees that network color programing has been greatly expanded; he knows that color set reliability is every bit as good as black and white; and he realizes that the price spread between the two has been reduced substantially in recent years.

In addition, the consumer continues to be in an expansive mood. All around him he sees favorable signs. The economy is strong. An excise tax cut has been proposed, and last year's change in the income-tax law provides for a further cut in 1965. His own personal income is probably up from a year ago, and as he drives to work he sees construction of every kind going on all around him. When he takes the family shopping he finds the stores crowded, with folks spending money at an unprecedented rate. Everything he sees and reads seems to indicate that 1965 will be another big year, a good time to buy the things his family needs.

In addition, the labor climate in the television industry has been favorable, the factories have been running smoothly, and the product distribution lines are full.

With the consumer well-to-do and in a mood to buy, and with the product widely available, reliable, and attractively-priced, it seems most likely that we will see new color-TV sales records established in 1965.

Along the same line, Harris Wood, manager of electronic engineering, points out: The independent service technician is one of our most important salesmen.

It seems evident, too, that anything we can do to improve the relationship between the serviceman and his customers will ultimately prove beneficial to us also.

This philosophy has produced at Philco a new service-slanted approach to manufacturing. Special innovations either make service work easier or reduce the amount of servicing time required. In the first instance, the inedependent service technician will benefit; and, in the second, both serviceman and customer. Less service time means more calls per day for the serviceman, and lower repair bills for the owner.

Two changes in Philco's 1965 color receivers make them easier to service. Printed circuit "roadmaps" have been further improved and are of course a prime service aid—a serviceman can trace printed circuits from the top without removing the chassis from the cabinet. Also, critical test points on Philco's

'65 color receivers—where measurements can be taken that will greatly speed up service work—have been moved up on top of the chassis, making them very easy to get at.

Radio Corporation of America — B. S. Durant, president—RCA Sales Corp., tells us: Color television, which became a million-unit business last year, should expand into a two-million-receiver business in 1965.

A sizeable shift to color was noted at the consumer level during the past Christmas season, with approximately 500,000 color receivers sold by the industry during that period. This momentum has helped start the current new year toward the expected 1965 color-sales total of 2.05 million units.

Slimmer cabinets and a greater variety of screen sizes will mark 1965's color television market. Though the recangular 25″ screen will appear in greater numbers, the tube's limited availability will be a factor in maintaining the present dominant position of the proven 21″ receiver.

There will be no significant price reduction in color television in 1965, I feel, but instead there will be a moderate decrease accompanied by sharply increased unit sales.

Competition from abroad, though talked about, will probably not amount to anything serious this year. The development of a substantial market at home is necessary before a foreign company can seriously enter the American market.

Sylvania Electric Products, Inc.— Gene K. Beare, president, feels that: During 1964, the field of color television, as related to the total television set market, made great progress. Factory sales of color television sets increased to $522 million in 1964 from $290 million in 1963, a gain of 79%. The dollar volume of color sets, at the factor level, represented 24% of all TV dollars in 1963, whereas in 1964 it accounted for 35% of total TV volume. We believe that in 1965 color sales will increase to the point at which they will represent from 45% to 50% of the entire video market.

Beyond 1965, we are certain that color will continue to grow in importance, and by 1969 will amount to 75% of the total television market. We project color set sales at the $1 billion annual level in 1967 and 1968, and 1969 volume at substantially in excess of $1 billion.

Because color television has such tremendous consumer appeal, we predict that it will grow from its present level to a point at which it has reached total home saturation equivalent to the 93% now enjoyed by black-and-white television. This probably will take from 10 to 12 years to accomplish—the timing dependent on such factors as how fast the major networks and local stations convert to a predominance of colorcasting, and the extent to which manufacturers are able to reduce receiver prices as a result of inincreased volume.

Zenith Radio Corporation—Joseph S. Wright, president, sums up: In 1964, Zenith Radio Corporation's sales of color TV receivers were almost double those of the previous year. On the basis of our record backlog of orders for color sets for delivery during the first quarter, we expect our color sales to continue to show another healthy increase in 1965.

Because of the current favorable economic background, plus the demonstrated advantages and dramatic appeal of color television, we at Zenith feel the explosive market for color TV receivers should continue to grow rapidly in 1965, with industry sales reaching about 2,000,000 units.

Zenith is backing up its belief in color TV with the third major expansion of its $15,000,000 color picture tube plant since completion in 1963. When this program is completed in the second quarter, floor space for the company's TV picture tube sudsidiary, The Rauland Corporation, will total more than a half-million square feet, and will provide annual productive capacity for more than 1½ million black-and-white tubes and nearly one million color tubes. This major expansion of facilities for color picture tubes provides facilities to increase the company's capacity for 25″ rectangular tubes and new facilities for production of 19″ rectangular tubes.

The Editor: The comments and suggestions of these industry leaders are quite significant to the professional service technician. From all the statements made, these facts stand out:

1. Color-set sales in 1965 are expected to reach 2 million, which will bring the total sets in operation to nearly 5 million.
2. Color-set sales dollars in 1965 are expected to reach $600 million, comprising 50% of the video market, and to increase their share in subsequent years.
3. Every TV-set manufacturer — even some who didn't want to be quoted — are anticipating a boom year for color, and either are in the thick of building or importing sets or are wrapped up in plans to enter the market.

For the television service technician and dealer, we can only say: A lot of dollars are going to be spent on color receivers in future years—for new sets or for service. (The average service-and-parts-cost per-set-per-year for modern color receivers is now $17.50. Multiplied by 5 million sets suggests a national service bill of $87½ million.) Your share of those dollars depends on how quickly and how thoroughly you prepare for selling and servicing.

By the end of 1964, some 52% of service technicians had begun handling color servicing, some competently and some not so. By the end of 1965, this number should be raised to 70%; and the matter of competency resolved by more and better training.

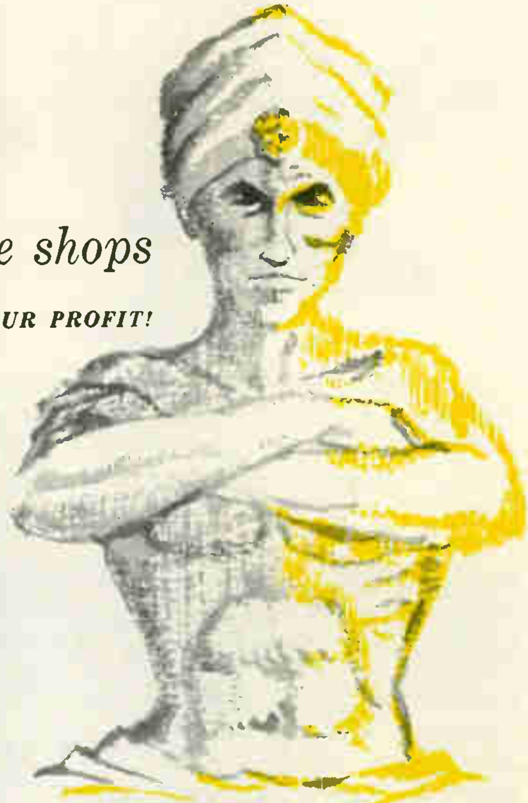
Most manufacturers furnish some form of color training, by correspondence or by clinic, free or at some cost. Training by some is more thorough than by others, but all are trying conscientiously to provide enough information so their sets can be serviced. Added to these efforts are the numerous service clinics being offered by test-equipment manufacturers—usually at no cost to the technician.

We urge every service-shop owner, every able technician, and every student of electronics to contact your distributors of electronic parts or television receivers (or both) and ask what steps you can take in your area to prepare for color-TV servicing. Your future is involved! ▲

MIRACLE WORKER

in professional TV service shops

PINPOINTS ANY TV TROUBLE FAST! UPS YOUR PROFIT!



DELUXE B&K MODEL 1076 B&W and COLOR TELEVISION ANALYST

with Crystal-Controlled Keyed Rainbow Color Display and Highly-Stable Horizontal Oscillator Sync

FLYING SPOT SCANNER

transmits B&K patterns or your own pictures onto TV screen

It's like having your own TV station! You can inject your own TV signals at any time, at any point—and quickly solve tough dogs, intermittents, any TV trouble, as you watch the generated test pattern on the raster. Checks any and all circuits in any stage throughout the video, audio, r.f., i.f., sync and sweep sections of the TV set. No external scope or waveform interpretation is needed. And if you wish, you can transmit your own slide-pictures.

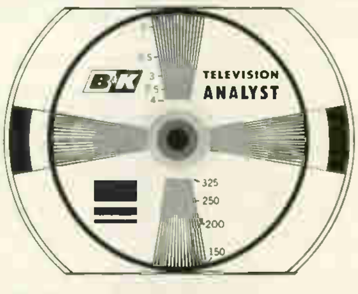
Makes Color TV Servicing Easy, Too.

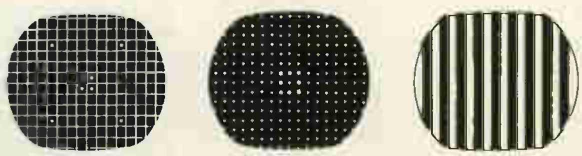
Generates white dot, crosshatch and color bar patterns for convergence. Generates crystal-controlled keyed rainbow color display to check color sync circuits, check range of hue control, align color demodulators. Demonstrates correct color values.

Saves time and work for the "pro." Makes servicing easier and faster for the beginner technician.

Most valuable instrument in TV servicing.

Net, $329.95





B&K

Profit with a B&K Service Shop
See your B&K Distributor
or Write for Catalog AP21-R

B & K MANUFACTURING CO.
DIVISION OF **DYNASCAN** CORPORATION
1801 W. BELLE PLAINE AVE. • CHICAGO, ILL. 60613
Canada: Atlas Radio Corp., 50 Wingold, Toronto 19, Ont.
Export: Empire Exporters, 123 Grand St., New York 13, U.S.A.

A look inside a color TV station

How the multihued signal is born . . .

by Thomas R. Haskett

Regardless of how well designed, manufactured, and installed a color TV receiver is, it's impossible to get clear, sharp pictures without the cooperation of a color-TV station. The station sets the standard to which all receivers in its area are adjusted, and as the originating point, it's worthwhile to take a good look inside.

To learn how color broadcasts are made, we visited WLWT of the Crosley Broadcasting Corporation in Cincinnati. This station was picked for a number of reasons: Cincinnati has more color sets per capita than any other city in the U.S. This is primarily due to WLWT's pioneering in color TV. The station, the first NBC color affiliate, has been doing local live color since 1957. WLWT aired the first color version of an indoor sport event (1959), the first night baseball game (1960), and the first remote pickup of religious services (1961); it is the only Cincinnati station doing local live color. WLWT is well-equipped with a total of seven color cameras—three studio, three remote, and one film. Half the station's programs are now in color, including almost all local programs. Only 9% of all TV stations are equipped to transmit color from all sources (network, film, tape, and local), and WLWT is one of them. Furthermore, the network of Crosley-owned stations in Columbus, Dayton, and Indianapolis is also being outfitted for color, with WLWC Columbus slated to receive local color cameras later this year.

Fig. 1. Studio color camera being adjusted with aid of scale charts on stand.

The Studio Camera

Where live actors and sets are involved, the unit used to get the picture is known as a *studio camera chain,* (Fig. 1) (photos courtesy WLWT). With its motor-operated pedestal dolly, it weighs nearly 500 lbs. and contains three separate highly sensitive pickup tubes, or *image orthicons.* These tubes operate like picture tubes in reverse; instead of viewing the image on the screen, the scene to be telecast is focused on the faceplate of the orth. tube. This image then travels to the *target,* where it is scanned by an electron beam. The signal on the beam is then taken off and amplified.

In the color camera (Fig. 2) a single lens is used, and an arrangement of mirrors splits the light rays into three separate paths, as shown in the block diagram of Fig. 3. Each is filtered so that tube No. 1 receives only red light, tube No. 2 green light, and tube No. 3 blue light. The images are then scanned from the targets, and the scanning-beam output from each tube is fed to a preamplifier. After the signal voltage is amplified, it leaves the camera via coaxial cable and travels

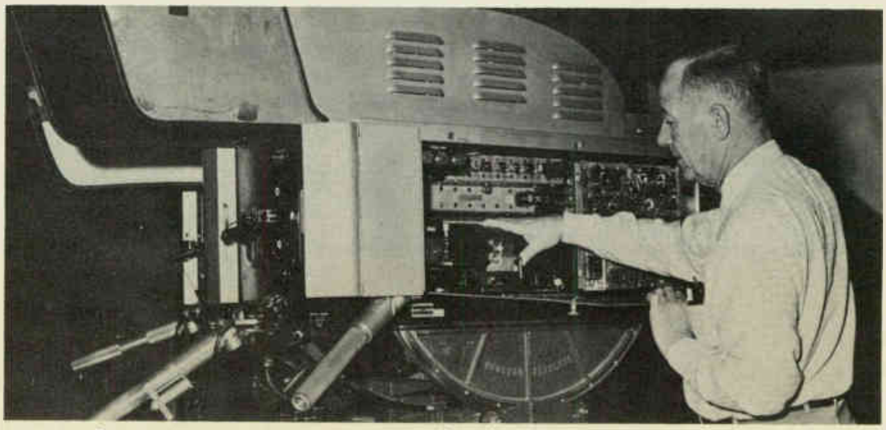


Fig. 2. Studio color camera with right-hand access panel open for servicing.

to the control room.

In the control room at the camera-control position (Fig. 4), a processing amplifier and colorplexer convert the RGB signals into Y, I, and Q signals; generate the color burst; and form the composite FCC standard color signal. From this point, the color signal is handled like any television picture, being switched and amplified until it arrives at the transmitter (Fig. 5). It is then converted to one of the standard TV channels and put on the air.

We learned that the early image orthicon, although it was the most sensitive of pickup tubes, had disadvantages for color. The required color filters reduced the amount of light that passed through to the tube, thus requiring more light on the set. Because the artificial lighting of night baseball games was limited, color coverage was impossible. However, in 1959 and 1960 the GE Tube Division devised a new orth. tube (type 7629, and later type 8092) which was more sensitive than the then existing tubes.

"They needed a field test of the 7629 and 8092, and WLWT provided it," said Howard Lepple, Director of Engineering Operations, Crosley Broadcasting Corporation. "During 1960 we did many of the home games of the Cincinnati Reds, which included several night colorcasts. Working with GE and RCA engineers, we were able to refine the tube to the point where it is now the most-used color pickup tube in the industry." He explained that the outstanding feature of the new tube is the target, which is made of magnesium oxide. "It's a wee bit noiser than older types, but that's not objectionable. What's important is that it's much more sensitive—it requires only about 150' candles of illumination, rather than the 500 required by the old type 5820. It means that we can do programs with normal black-and-white lighting. Furthermore, the new tube doesn't burn-in or stick like the old ones." (I was told this referred to the 5820's habit of retaining an image in outline form after being focused on it for a while.) "One more thing," added Lepple. "These new tubes cost very little more than the old ones, but they also last longer."

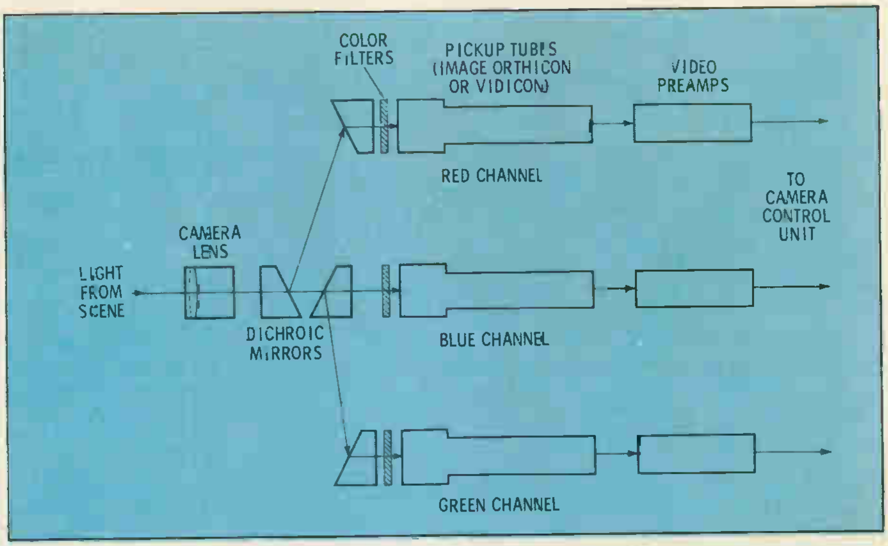


Fig. 3. Simplified block diagram of three-channel color camera circuit.

Ed Dooley, WLWT's Chief Engineer, had another idea: "The new magnesium-oxide tube has a far-reaching impact. Since we can now do a color show anywhere that we can do a black-and-white show, it's much easier to convince an advertiser to buy color. Lighting is no problem, and we don't have to worry about the additional heat of extra lights, which used to be an air-conditioning problem. All this means that we can do *more* color programs than ever before. This, of course, means more incentive for people to buy color sets. *That* means more sales and, eventually, more color service work."

Films and Tapes

No TV station runs entirely on live cameras, and color is no exception to this rule. Nearly all station breaks, spot commercials, and promotional announcements are on slide, film, or tape. WLWT has converted all of its slides to color, and all station breaks are now done in color. Slides and films are picked up by a *film camera chain* (Fig. 6) that uses three *vidicon* pickup tubes. The vidicon is less expensive than an image orth. and is more stable. It's less sensitive and requires more light, but this is no problem, since it's relatively easy to provide intense lighting on the small one- or two-inch area of a slide or film frame. Operation of the 3-V camera (so called because of its three vidicons) is similar to the studio color camera; it contains splitting mirrors, color filters, preamplifiers, and a processing amplifier. The 3-V camera requires less frequent alignment than a studio camera, because the

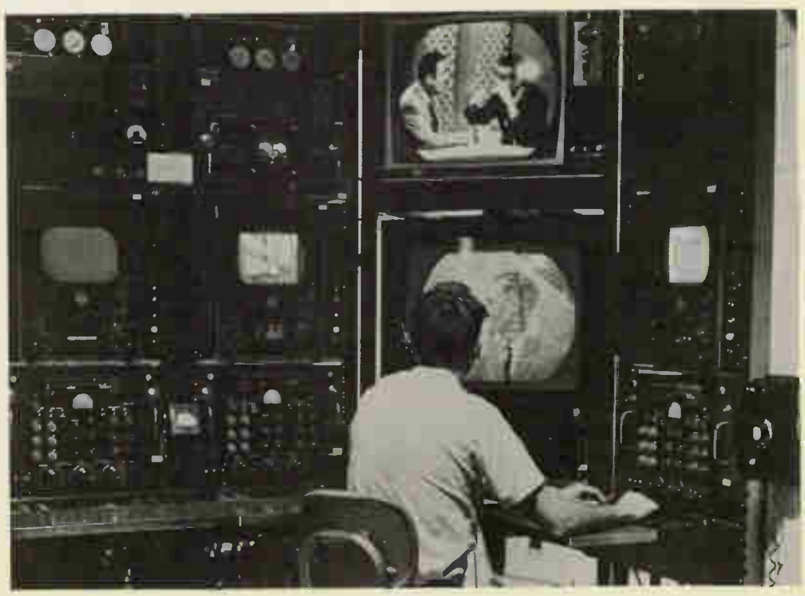


Fig. 4. Operator shown at work in studio color-camera control position.

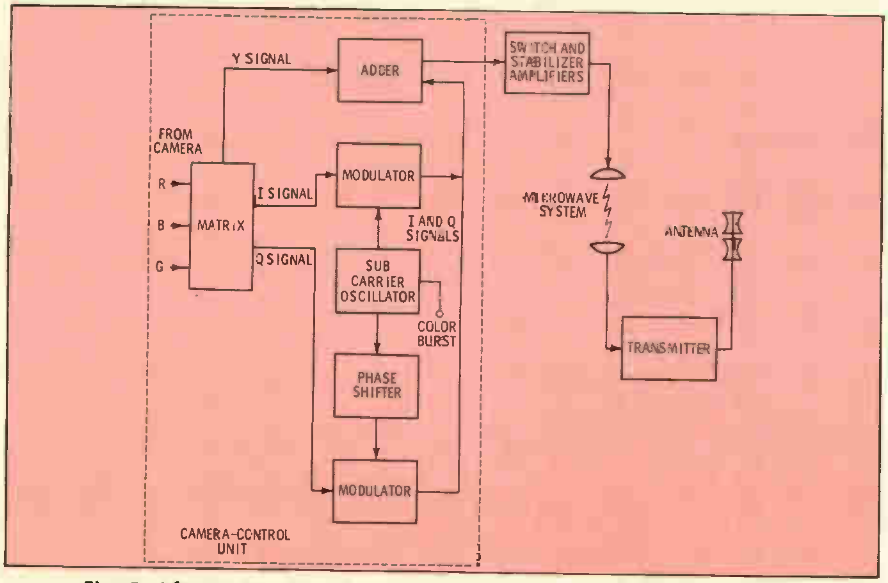


Fig. 5. After processing by camera control, color signal is transmitted.

slide and film projectors are rigidly mounted and are seldom out of adjustment. The 3-V camera is not movable, and the various projectors used with a single camera are multiplexed by means of mirrors so that their images reach the vidicon target.

Until recently, tapes of color programs were apt to shift hue somewhat, because early video recorders did a marginal job on color information. WLWT has two video recorders. The first, acquired in 1959, has not always made the best color pictures. The second, bought in 1961, has a completely new color-processing system that produces stable true-to-life color pictures. A video tape recorder is a complex device; its sophistication derives from the fact that a very high head-to-tape speed is required to reproduce the wide (4 mc) bandwidth of a color picture accurately. Conventional audio recorders that use a speed of 15 ips have only about 30,000-cycle (.03 mc) response. The video recorder passes the heads *across* the tape at the same time the tape passes the head assembly, thus multiplying the speed and making it possible to record all sync, luminance, and color signals.

Setting Up the Equipment

We stopped at WLWT's Studio A, the main color studio, to observe an engineer setting up a color studio camera (Fig. 1). First he used a *registration* chart to check the geometric linearity of each color channel as it was superimposed over the other two. Then the image was checked for sharpness and clarity with a *resolution* chart, which indicates high- and low-frequency response, or sharpness of fine detail and lack of smear in the picture. Then the camera-control engineer in the control room (Fig. 7) assisted the cameraman as he focused on a *gray-scale* chart (to check black-and-white reproduction) and a *color-bar* chart (to check color reproduction). They adjusted the processing amplifier and the red, green, and blue channel controls until the hue and saturation balanced. "The most important channel for resolution," said Lepple, "is green. If *it's* correct, the final picture looks good." I asked what other differences there were between the three color channels. Dooley said, "The blue is least sensitive. If you use three similar orth. tubes, you must filter the red and green channels to compensate. But we don't do this. We buy a slightly "hotter" tube for the blue channel, and use the standard type for the red and green channels. All are actually magnesium-oxide types, but they are selected in a group of three."

After being electronically set up, the camera was checked for proper hue by focusing on a color picture of a young woman. I was told that either a live model or a photo is used to make the final hue adjustment; the adjustment is set so that the flesh tones look "natural."

Looking ahead, I asked if the day would come when all of WLWT's programs might be in color. "While I can't say when," said Lepple, "I think they will be someday, We're

Color Facts

Color Yesterday

As in the early stages of any art, errors were made in the early days of color broadcasting. Color stations have at one time or other been plagued with poor color. It simply takes a while to get the bugs out of equipment, and it takes time for the engineers to adjust to working with a new medium. Early color tapes, for example, were poor.

Color Today

Of all TV stations on the air: 79% can transmit color, 26% can show color films and slides, 11% can produce local live color, and 9% can program color video tapes.

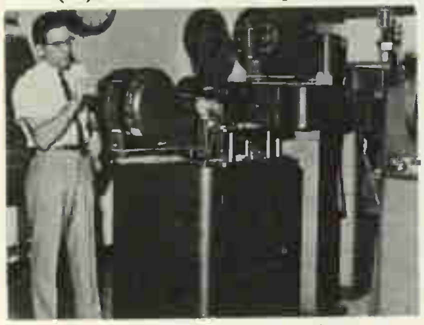
Most color stations have from 5 to 10 years' experience with the medium. They know what they are doing, they know the equipment, and they know that the equipment is greatly improved over their original gear.

Color Tomorrow

At least two developments promise to increase color quality:

1. The four-channel color camera produces crisp, sharp pictures on both color and black-and-white receivers. In addition to the usual red, green, and blue camera tubes, a fourth tube is used to pick up luminance, or black-and-white information. This luminance channel reproduces fine detail and extends the fidelity of the color system beyond that which is being broadcast today.
2. Ampex has just introduced a new *Videotape*® recorder capable of making true-to-life third generation copies. Since networks use taped time-delay for most programs, and local stations make copies, the actual air program will be much closer to the original and taped shows no longer will be "second best."

(A) Two 16-mm film projectors



(B) Two 35-mm slide projectors

Fig. 6. Inspection being made of two portions of the film color-camera chain.

Fig. 7. Color control room shows camera shots before selection for viewing.

gaining more color time every year. Most of our viewers assume that if a station break *isn't* in color, something is wrong with their set. Sometimes they call us about it."

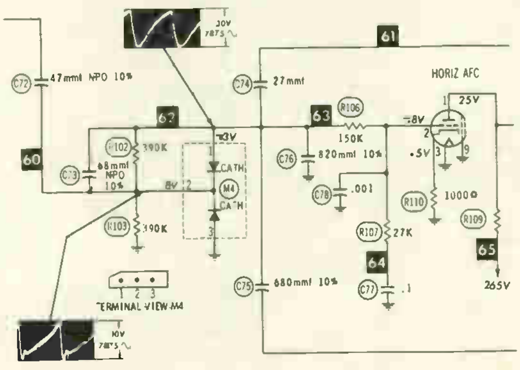
Dooley added that one of the most popular segments of the station's schedule was the 7:00 to 7:30 PM slot which is in color four nights a week with syndicated half-hour films. "It has the highest rating in town at that time. In addition, many of our feature movies are in color," he said. "Viewers seem to like color films."

Lepple summarized the feelings of WLWT's staff: "In our eight years of color, we've had many problems, have solved most of them, and have learned a lot—and above all, we've had fun." ▲

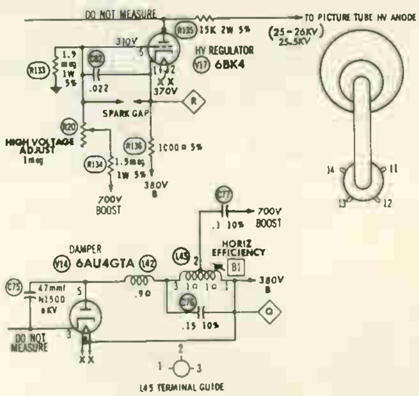
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: RCA CTC11
Symptoms: Raster has shifted to one side of screen.
Tip: The customer's first complaint will probably concern the raster shift described above. You'll naturally use the horizontal centering control to return the picture to its proper position. However, if you run out of horizontal centering range (control set all the way to one end), or if you get a callback within a short period of time for this same complaint, you might well suspect trouble in the horizontal centering circuit. Before you check that circuit for trouble, replace the horizontal AFC diode; then fire up the set, and check to see if the raster has shifted back to its normal position (with the centering control back to its original setting). If it has, you've found the trouble, and there is no need to check the horizontal centering circuit. Defective AFC diodes have been known to cause this trouble in these chassis, without affecting horizontal sync.



Chassis: Zenith 27KC20, 29JC20
Symptoms: Intermittent focus.
Tip: This trouble is generally caused by nothing more than misadjusted controls in the horizontal circuits—the horizontal efficiency coil and high-voltage potentiometer. The symptom will be further aggravated if the CRT controls happen to be set too high, so check them first and readjust if necessary; it's a good idea to keep the screen controls at the lowest possible level consistent with proper gray-scale tracking. Next, adjust the high voltage, output current, and regulator current as described in the service information. All these adjustments can usually be made without pulling the chassis.

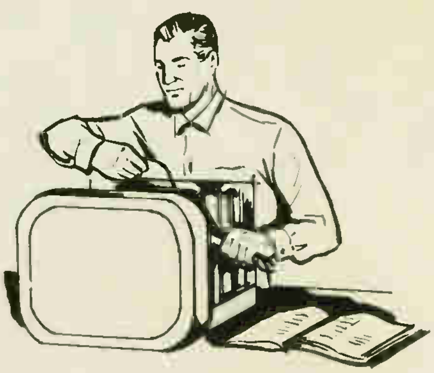


WorldRadioHistory

Building a color TV kit

Learn about color by working with it this way . . .

by Leo G. Sands



Now that color TV is getting into high gear, it is becoming increasingly important for radio-TV technicians to master color TV in order to avoid loss of business. One sure way to learn about any electronic device is to build one and then de-bug it. In fact, it was during the home radio building days of the roaring '20's that radio service technicians were spawned, and the boom in kit-built test equipment bears out this assumption.

The AM broadcast receiver went through a kit and design-it-yourself era. But, black-and-white TV had only a mild kit flurry because factory-made sets became abundant quickly and in tremendous quantities. Nevertheless, b-w TV kits are still available and sell for more money than factory-built sets.

There are also color TV kits on the market which sell for as much as factory-made sets. Kit buyers are

Finished color set has all appearances of factory-built unit, if care is used.

not bargain hunters. Instead they buy and build their own color-TV kits because they either want to learn more about color TV or want more quality for their money. The cost is greater, however, only if the builder puts a monetary value on his time.

Anyone who can read and follow simple instructions can assemble and wire a color-TV kit. But, for a technician, building should be much easier and far more beneficial in experience. By building a color-TV from a kit, you can become intimately familiar with the circuits far more quickly than through servicing color sets blind or even with the aid of a service manual. When building a kit, you become involved with every part of the set and, if you pay attention to the assembly manual, you learn why each part is required. After you have built the set, you can sell it or keep it for your own viewing or later experimentation.

Building a kit gives you a kind of experience similar to that gained by a lab technician who is assigned the task of breadboarding a new circuit or assemblying a prototype. And, if you make any goofs, you build in your own troubles which you can troubleshoot.

The Heathkit GR-53 color TV kit, the one most widely familiar, comes partly assembled. The subassemblies include some circuit boards which employ factory pretuned circuits such as IF transformers. The VHF and UHF tuners, of course, are factory-made.

The first step in assembly is to read the assembly manual which has more than 100 pages. The booklet contains color pictures of what you should see on the screen, plus plenty of technical meat on theory and troubleshooting, as well as alignment procedures. If you understand what's in the book and build and adjust the set, you will have accumulated a pretty solid familiarity with color TV.

Since there is a built-in dot generator and the IF circuits are prealigned, you hardly need any test equipment—a VTVM will locate most boo-boos you may have made in the wiring. A nontechnical person will usually follow the assembly and wiring instructions with great care, and chances are the set will work when it is first turned on. But, a technician may feel so sure of himself that he rushes right in—increasing the chance for wiring error.

After you have the set operating, use your scope and VTVM to trace signals and check voltages. Even if the set is correctly aligned, hook up your signal generator and get the feel of the alignment. When you acquire special color-TV test equipment, you can practice using it on your own properly operating set before you tackle customers' sets with it.

While you can undoubtedly buy a factory-made color set at a wholesale price considerably less than the kit price, in the kit you will be getting a set that has not gone through the cost-reduction engineering stage. Most factory-made sets in the lowest price range contain only bare essentials. For your purposes, you need a set with all the circuits left in. Then, in your servicing, you'll be prepared to tackle the deluxe models as well as the price leaders. ▲

247 WAYS TO MAKE MORE

From now on, color-TV work is going to bring in a bigger and bigger part of your income. And RCA has EVERYTHING to make color-TV service MORE PROFITABLE for you.

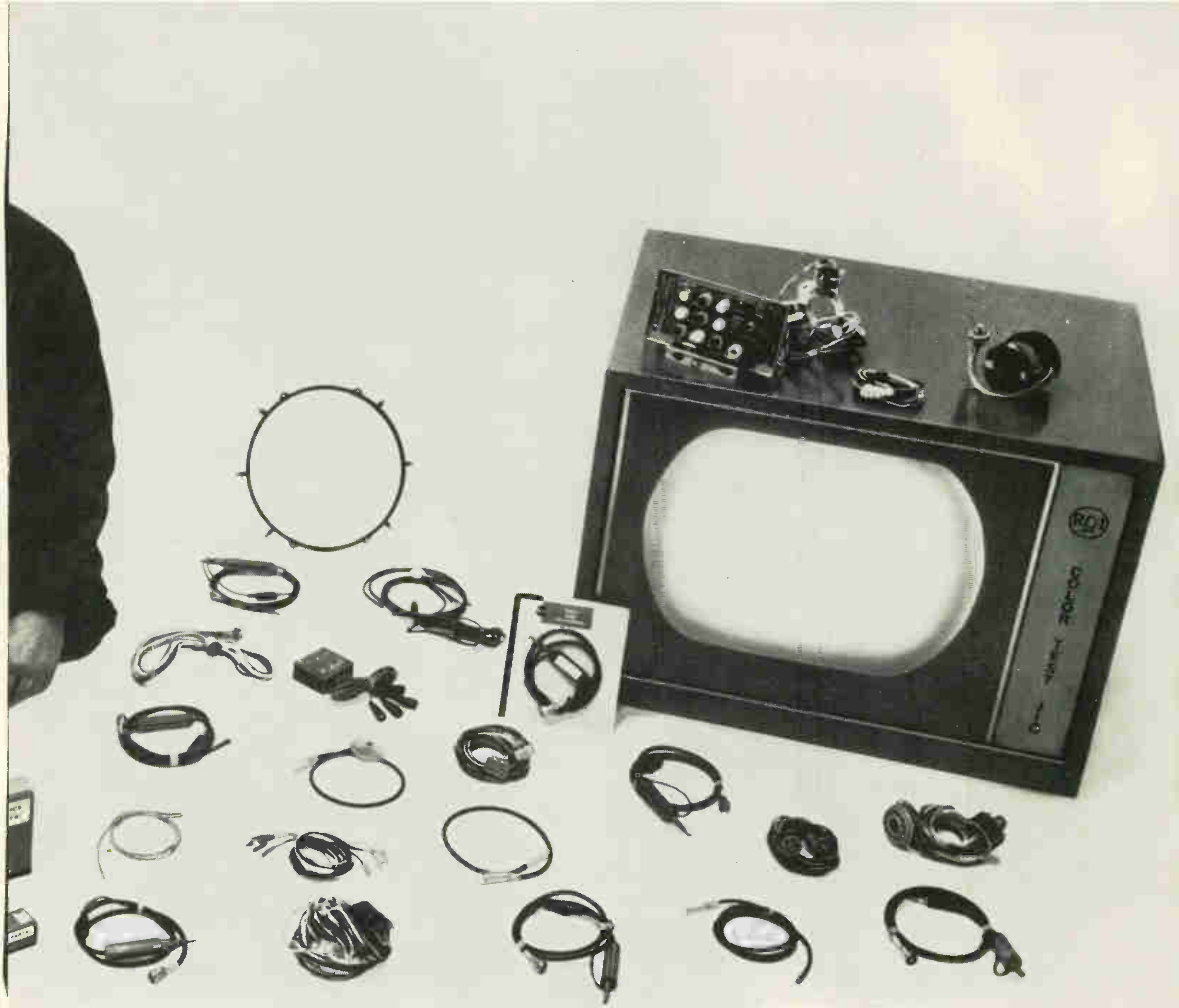
To save you money and manhours.

To increase your efficiency so you can get more jobs out in the same time.

To eliminate those time-wasting extra phone calls and trips to the distributor.

Take the famous RCA Color-TV Test Jig (large unit at right). *It cuts manhours in half* on a color house call. Without it, when you have to pull a set into the shop, it takes two men. With it, it takes just one (you pull the chassis only—leave the color tube and the cabinet). That means MONEY *. . . extra money for you.*

Take the RCA Color Parts Rack (large unit at left). The rack is FREE when you buy the basic complement of 120 most-needed color service parts. Keeps your color parts neatly organized, all in one place. Simplifies restocking, lets you know what you're short of. No more running out of a vital part just when you need it—which slows down a job.



MONEY IN COLOR-TV SERVICE

That means MONEY... *extra money for you.*

Take the other color service parts arrayed in the photo and listed at right. Degaussing coils, transformers, chokes, yokes, connectors, cables, replacement parts... each with a special function to save you time, to increase the quality and accuracy of your work, to help you cut down on call-backs. That means MONEY... *extra money for you!*

245 specialized color service parts in all. The Rack and the Jig make it 247. And all of them mean MONEY... *extra money for you.*

RCA PARTS AND ACCESSORIES, DEPTFORD, N. J.

RCA® **The Most Trusted Name in Electronics**

RCA Parts and Accessories for color-TV service include: *Color Test Jig*—to test all RCA color-TV chassis • *Color Parts Rack*—sturdy, well-organized unit containing complement of 120 most-needed color-service parts • *Degaussing coils*—to demagnetize picture tube and chassis • *Special-purpose extension cables*—to extend kinescope socket, deflection yoke, convergence magnet and kinescope high-voltage leads when chassis is removed from cabinet for servicing • *Special alignment probes*—video detector test blocks, IF test blocks, sound detector test blocks, mixer grid matching pad, tuner IF input head • *High-voltage interlock plug*—to by-pass high-voltage shorting switch • Plus sockets, transformers, fixed and variable capacitors, reactors, resistors, diodes, switches, coils... EVERYTHING to save you time and make *more money for you* in color-TV service.

solid-state color TV systems

Analysis of circuits peculiar to transistor sets . . . by Joe Risse

As of press time, a survey of manufacturers and industry experts indicates that there are no transistorized color TV receivers being commercially manufactured or sold in the U.S. But a year from now the story might be different. At least, one U.S. concern, a major manufacturer of semiconductors, has a developmental model in its lab. This company, Fairchild Semiconductors of Mountainview, California, confirmed this in mid-February.[1] Though details were skimpy, the receiver utilizes approximately 50 commercially available Fairchild semiconductors and the single-gun Chromatron picture tube; manufacturer of the Chromatron is Paramount Pictures, who holds the basic patent-rights on this tube.

Other U.S. companies are undoubtedly hard at work also toward transistorization of color receivers, but, on being queried, reported that their plans did not call for offering one in the immediate future. Several Japanese companies, on their own or under agreement with U.S. manufacturers, appear to be on the brink of coming up with something soon.

Most of the known activity on experimental, developmental, and, pending transistorized color is based on the Chromatron, or prototypes of it, according to David Lachenbruch, Editorial Director of TV DIGEST. That a Chromatron type of color tube is likely to be included in the first transistorized color set coming out of Japan for the U.S. market was also confirmed by Robert E. Gerson, Electronics Section, of the Japan Trade Center, New York City. The Chromatron, known earlier as the Lawrence tube (its development was led by Ernest O. Lawrence), is licensed by Paramount to Sony of Japan for production. Under this licensing agreement, Sony can manufacture both in the U.S. and Japan, and is said to be ready to come out with a 17″ color vacuum-tube set using the Chromatron.

With few exceptions, the remainder of transistorized-color planning seems to lie with projection-type systems which utilize three monochrome picture tubes. One (not the only) exception is that Philco is said to be showing a reactivated interest in its Apple tube and plans an extensive color-television research program. The Apple tube, like the Chromatron, is a single-gun tube.

A French company, Videon, manufacturers a fully transistorized color receiver. This receiver, a three-picture-tube type, is designed for reception of SECAM system transmissions. (SECAM is the color system being vigorously advocated by France as the standard it feels should be adopted for all of Europe.) The Videon receiver, removed from its cabinet, is shown in Fig. 1. Videon feels they have a worldwide first. The receiver was exhibted at the Paris Exhibition of Electronic Components in February 1964. Videon official M. Chauvierre related in late January 1965: "We believe that our model is the first color TV receiver to be entirely transistorized, Japanese sets being still of a mixed type. We also wish to point out that the decoder used has been especially designed for the reception of French experimental color TV broadcasts with the SECAM system and would not therefore be suitable for the American NTSC system."

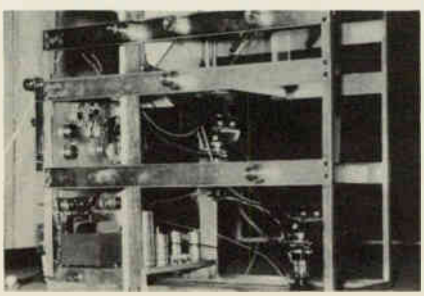


Fig. 1. Color by using three images which are combined by special mirrors.

There is little doubt that the U.S. transistor art has reached the point where transistorized receivers using three-tube color systems could be designed; its not likely that much of a market would exist for sets of that type, however. Projection television systems have seen little demand since the early days of black-and-white television because of their bulkiness and weight.

Why Not Large Screens?

One apparent reason for the absence of transistorized color receivers using large-screen shadow-mark tube seems to center mainly around the horizontal-deflection circuit—available transistors are not sufficiently rugged to provide the power required to deflect the beam in large-diameter shadow mask tubes. This is the opinion of Harold Walker, U.S. TV-industry expert, inventor, designer of CCTV, ETV, CATV and Pay-TV systems, and TV engineering consultant to the French government. The Chromatron single-gun tube, with a smaller neck diameter, places the deflection coils closer to the beam so they require less driving power, according to Walker.

For the shadow-mask tube of 23″ size, requiring 23 kv of high voltage, Mr. Walker states: "At least 18,000 volt-amperes of deflection

[1] Electronic News; Feb. 15, 1965; "Transistorized Color Near."

power is required. The present capability stands at about 12,000 volt-amps, pushing presently available transistors to the limit; 8,000 volt-amps is actually a more practical figure for present units."

To illustrate design requirements and present-day limits, Mr. Walker provided Table 1 especially for this article. The table lists second-anode kilovolts in the extreme left column, as required for the various screen sizes shown in the second column. The deflection power is shown in volt-amperes (peak flyback voltage times peak amperes), for both 90° and 110° picture tubes, and for neck sizes from ⅝" to 2".

Design limits of existing transistors are also indicated by a line drawn diagonally across the chart. For example, a 110° tube having a 2" neck, a screen-size of 14", and 12 kv on the HV anode, would require 2400 volt-amps of deflection power. The limit line indicates that design of a transistorized deflection system for such a shadow-mask color tube is just barely attainable. As the state of the transistor art improves, naturally the limit line on the table can be moved downward.

The Chromatron Tube

It does not seem that an all-transistor color-receiver using the three-gun shadow-mask with 2" neck will be making an immediate appearance. But, a few Chromatron-equipped sets may be marketed here and there before much longer. In preparation for servicing them, a review of the main features and characteristics of the Chromatron tube ought to be worthwhile at this point.

While the conventional shadow-mask tube is based on the simultaneous display principle, (one, two, or three of the sets of phosphor dots are excited simultaneously by three guns), the Chromatron is a single-gun tube with dot-sequential display. Sets of three primary color phosphors are excited one after the other in rapid succession by a single beam. The beam is modulated in a way that produces the saturation needed by each color dot to contribute to developing the proper color. If all red, blue, and green dots in a group are excited, proper illumination by all three causes white light;

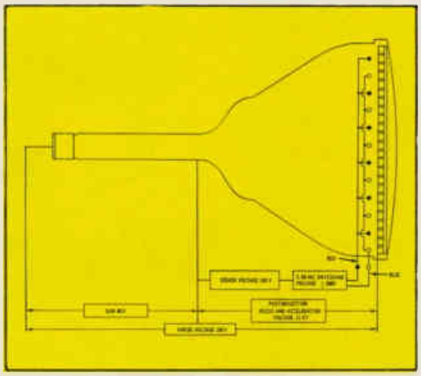


Fig. 2. Chromatron driving circuitry.

different combinations of dot illuminations give different colors. The NTSC video signal, which contains simultaneous information for all three colors, can be processed and gated to excite the dots in sequence exactly as the beam passes over the correct segment of the Chromatron screen. The mechanical construction (Fig. 2) is similar to that of a conventional monochrome tube, except for the screen. The screen is made up of red, green, and blue phosphor strips, repeated from top to bottom in horizontal pattrens. Grid wires are placed in front of each red and blue strip, with all red grids and all blue grids connected in parallel and the two separate circuits brought out to socket terminals.

When no potential difference exists between a blue grid and a red grid, the beam passes midway between red and blue strips and excites a green phosphor strip. When the red grid is positive with respect to the blue grid, the beam is deflected to a red phosphor strip; when the blue grid is positive, the beam excites a blue strip. All three primary colors are produced when the beam moves up and down rapidly (at the 3.58-mc subcarrier frequency) over all three strips during its horizontal sweep, and this causes a white raster.

The rapid up-and-down switching of the beam at the 3.58-mc rate is accomplished by applying the 3.58-mc signal alternately to each of the pairs of red and blue strips. The capacitance between strips and an added inductance form a high-Q resonant circuit—the higher the Q, the less 3.58-mc driving power is required.

A *seeker* voltage is applied (Fig. 2) between the electrical center of the envelope and the color-grid circuit; its purpose is to accumulate secondary electrons emitted from the color grids, preventing them from distorting the uniformity of electrical fields within the tube.

Focusing of the beam takes place beyond the deflection point; for this

TABLE 1

*DEFLECTION POWER FOR VARIOUS PICTURE TUBE SCREEN AND NECK SIZES

		VOLT-AMPERES OF DEFLECTION POWER (PEAK FLYBACK VOLTS TIMES PEAK AMPS)							
KILO-VOLTS	SCREEN SIZE, INCHES	For 90° Bulb, of Neck Size				For 110° Bulb, of Neck Size			
		⅝"	1⅛"	1½"	2"	⅝"	1⅛"	1½"	2"
6	6 to 9	400	550	800	1000	500	700	1000	1200
9	6 to 9	600	900	1200	1400	750	1100	1500	1800
12	14	800	1150	1600	1900	1000	1500	2000	2400
15	17	900	1300	1800	2100	1300	1800	2500	3000
18	21	1000	1500	2000	2400	1500	2200	3000	3500
22	23	1200	1800	2400	3000	1900	2800	3800	4500

Below this line is beyond ability of present-day, production-type single transistors

** All values shown are approximate

reason, the Chromatron is also referred to as a post-deflection focus tube. The post-deflection focus and accelerating voltage is applied between the color grids and an aluminum backing on the phosphor strips; this voltage acts to concentrate the beam into a spot smaller in size than the width of one phosphor strip.

The required intensity of illumination by each phosphor strip is obtained by modulating the beam in accordance with its instantaneous position. Gating circuits, one for each of the colors, provide this intensity information. For red and blue, gating is at a 3.58-mc date; for green gating, the gate-rate is double because the beam passes over a green strip twice as often as over the red and blue strips. Precise sync is a necessity between the gating action and the 3.58-mc signal applied to the red and blue strips. To compensate for the double scan of the green phosphors, the green gating signal is half the width of the red and blue gates. Actually, an adjustment is provided for each of the three gates in order to balance the amount of excitation of the three phosphors. ▲

Electronics at the World's Fair

by Forest H. Belt

Gate 1, the main entrance for most Fairgoers, opens directly in front of the RCA Color TV Communications Center, as you can see from Fig. 1. RCA plays a many-faceted part, providing dozens of services for the overall operation of the Fair and widespread facilities for broadcasts originating within the giant Fairground. The ultra-modern RCA building is laid out in the shape of three large cylinders on a 30,000-square-foot plot.

In the part of the exhibit that comprises the first cylinder, the visitor can stand in front of a live color television camera and see himself in both front and side views. For the 600 persons-per-hour who visit the RCA exhibit, however, the principal attraction is a guided tour of an operating TV broadcasting studio and control room, contained in the other two cylindrical sections of the building. The studio and control room are surrounded by a glassed-in elevated walkway that completely encircles the extensive facilities. Through the glass, visitors can see action in both the studio and control room. They can watch every move of

Fig. 1. Main entrance to World's Fair.

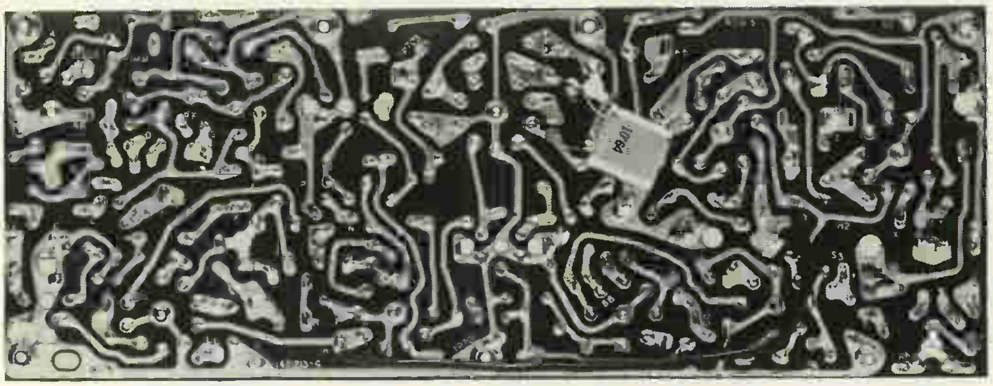
the directors, producers, and control operators, observe cameramen dollying in and out, and view, on several monitors, the results of those activities. They can also see how shows are taped, played back, retaped, and edited, and view all programs on monitors located throughout the building.

To serve the Fair itself, RCA's facilities will soon become part of the world's largest CCTV system, feeding some 300 color receivers situated throughout the Fairground. Programming will include: spot news reports from various points on the premises using a complete mobile color-TV studio; aid in locating lost articles; and other helpful highlights.

The RCA color CCTV facilities are also used to aid Pinkerton police in returning missing children to teachers or parents. Lost children are brought to the color studio where their picture is broadcast over the Fairgrounds system with instructions for reclaiming them.

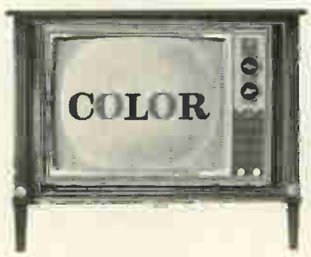
An impressive array of station equipment fills the racks and panels of the control room. Three video tape recorders stand ready to record any of the program material for rebroadcast at any time, and elaborate video- and audio-control consoles permit broadcasting or recording any form of AM, FM, or TV show. In the circular studio, illumination is provided by the very latest **Kleigl** lighting equipment. Thus, color-sensitive electronic eyes serve the Fair from the most modern color-TV center ever built.

RCA Solid Copper Circuits



replace old-fashioned "hand wiring"... RCA Solid Copper Circuits are the circuits of the space age

RCA Solid Copper Circuits are made by methods as modern as tomorrow. They give greater dependability . . . better TV performance. It's typical of the advanced design you'll find throughout every RCA Victor home instrument. It all adds up to sets that are easier to service so that owners are more satisfied with results.



RCA The Most Trusted Name in Electronics

Tmk(s)®

More TV servicemen own RCA Victor Color TV than all other leading makes combined

"HIS MASTER'S VOICE"

COLOR TV Service Aids From GC/WALSCO

GC & WALSCO HAVE PIONEERED COLOR TV SERVICE AIDS SINCE THE 1ST COLOR TV SETS WERE INTRODUCED!

WALSCO DEGAUSSING COIL

PORTABLE TUBE KADDY SIZE!

Molded case with momentary switch!

Only 7'' in Diameter,

Use
Demonstrate
Sell

Make $4.00 on each Color TV service Call!

No.	List	Net
2592	9.95	5.95

GC Deluxe DEGAUSSING COIL

For Bench Service in Your Shop

Eliminates stray magnetic fields in Color TV Sets prior to purity adjustments. Coil is completely enclosed in hi impact molded plastic with 9' cord and momentary switch. Easy to use, will last a life-time.

No. 9317..... Net 17.97

GC GRID GROUNDING BOX

For Easy Convergence and Matrix Adjustment

Permits grounding of color control grids through built-in resistors. Grounding lead has alligator clip-grid leads have ingenious push-on terminals which pierce wire insulation for best contact.

No. 9318.. Net 5.10

GC COLOR TV RECTIFIER KIT

One kit needed to service nearly all makes of Color TV Sets including RCA, Zenith, GE, Philco, Emerson, and many others. Kit includes Focus Rectifier, Voltage Booster Rectifier, and Silicone Diode, plus complete cross reference information.

No. 16-500 ......Net 4.40

Replaces OCILLOSCOPE For FAST ADJUSTMENT

Three transparent optical filters sealed in permanent plastic simplifies phase and matrix adjustments on color TV sets using a saturated color for signal. Just view the bar signal through one of the filters and make necessary saturation and hue adjustment. No. 9309 .... Net 1.50

COLOR TV HARNESSED & SOCKETS

FOR SERVICE & REPLACEMENT

GC No.	Description
9436	RCA No. 937848 Adaptor 25AP22 socket to 21AXP22 base
9437	RCA No. 13B111 and 937846 service extension 25AP22 socket to 25AP22 base 48''
9438	RCA No. 13B111 and 937847 service extension 21AXP22 socket to 25AP22 base 48''
9439	21AXP22 socket to 21AXP22 base 48''
9441	21'' socket and lead replace 21AXP22
9443	25AP22 replacement socket with lead

Write for FREE COLOR TV SERVICE GUIDE BOOK FR-067-W! Enclose 10¢ to cover cost of mailing!

Buy & Install COLORMAGIC TV Antennas. A must for all Color TV Installations.

GC ELECTRONICS

GC ELECTRONICS

DIVISION OF TEXTRON ELECTRONICS, INC.

EASTERN PLANT: HICKSVILLE, L.I., N.Y.
WESTERN PLANT: LOS ANGELES, CALIF.
MAIN PLANT: ROCKFORD, ILLINOIS, U.S.A.

GC ELECTRONICS

RECOMMENDED BY

PHILCO

for COLOR

& BLACK AND WHITE TV INSTALLATION

COLORMAGIC

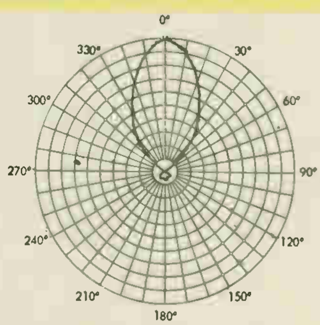
FHR

FUNDAMENTAL HARMONIC RESONANCE...GC'S EXCLUSIVE DESIGN PROCESS! Colormagic elements resonate on the fundamental harmonics within both the high and low bands. Colormagic FHR outperforms the average second harmonic TV element by producing a tight, laser-linked directivity of signal...higher gain! It's in the elements!

GC "GOLD-GUARD" anodizing process guards against pitting, chipping, rust and corrosion...makes the Colormagic series the best protected, all-weather line available!

GC "SOLID-SEMBLED" construction insures quick, easy installation...rigid-lock elements snap securely into place!

Compare! Colormagic Antenna Systems offer pencil-point polar patterns...laser-linked directivity ...flat plateau response curve... no traps or peaks...excellent for color or black & white TV reception.



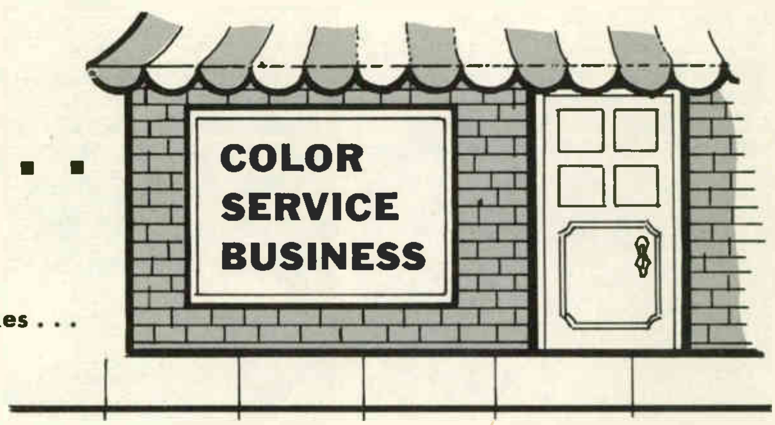
15 All-New Colormagic Combo-Couplers permit cross-direction reception of UHF-VHF-FM antenna combinations...each unit encased in high-impact polystyrene case...supplied with stainless Steel mounting strap. Complete sales program available.

See your GC Distributor! He'll fill you in on this "prestige" package. *CONSIDER THE ELEMENTS INVOLVED!* ...then GO COLORMAGIC! If not stocked locally, write us for name of Distributor nearest you.

GC ELECTRONICS
DIVISION OF TEXTRON ELECTRONICS, INC.

EASTERN PLANT: HICKSVILLE, L.I., N.Y.
MAIN PLANT: ROCKFORD, ILLINOIS, U.S.A.
WESTERN PLANT: LOS ANGELES, CALIF.

STARTING A . . .



It pays, if you have what it takes . . .

by Forest H. Belt

There has to be a beginning. For some technicians, the beginning would be hard to pin down. They can't remember just when they actually started thinking of themselves as color-TV technicians; they just sort of drifted into it. A customer got a set, and called them to service it. Pretty soon the word got around, and suddenly they were servicing color regularly. And liking it. And making money at it.

With the boom that is taking place in the field of color TV, a new breed of color specialists has sprung up. In many cities, you'll find shops that service color almost exclusively. Their monochrome activities are confined to second sets in homes where the first set is color.

Sometimes these specialists have an entire shop devoted to color servicing; some include sales quarters. Others—and these are even more numerous—have set up within established shops. The result is the same: a service technician who is making his sole living servicing color receivers.

These facts are signs of the times. Readers ask us more and more frequently "Can you tell me how to get into the color servicing business?" "What instruments will I need?" "What parts should I stock?" "How much investment should I plan?"

Answering these questions has been the subject of several articles in this issue—our annual Color TV Special Issue—and in several other issues through the past year. Even last year's Color TV Special was filled with articles on the subject. Most of these have been written about the technical aspect of color servicing; we'll try to answer some of your other questions in this article, those pertaining to exactly how to go about starting a color servicing business from scratch.

Know Your Stuff

Our first admonition to the would-be color specialist is almost academic, but we're going to say it anyway:

Be sure your technical knowledge and experience are of "specialist" quality. There is no substitute for these; you must have them if you are to be a success in color servicing.

If your understanding of color is a little hazy, review! Attend the service clinics held regularly by color TV manufacturers; most of them are free. Go through some of the fine color-servicing textbooks now available (a few are listed in Table 1). Work for awhile in a shop that services color sets; gain that valuable experience. When you decide to become a specialist, be sure you have the stuff specialists are made of.

Is a Color Business Different?

Not really. That is, you will need the same things to start a color-servicing business that you'd need to start any other kind. You'll need operating capital to tide you over until the profits start accumulating. Don't start without reasonably solid financial backing, whether it's your own or someone else's.

You'll need a location. Will you sell sets? If so, you'll need a spot where prospective customers can find you easily; in fact, a dense-traffic location will be best. But perhaps your financing won't permit a high-rent area. Settle for the best you can find where you won't be tucked away from the world. If you're not going to sell sets, maybe you prefer privacy. Customers are not likely to carry their color sets in for service; so if you're a service-only shop, location isn't of great importance. Just make it nice enough you'll not be ashamed for your customers to drop by.

You'll need certain test equipment. Space doesn't permit covering this facet in great detail, but other recent PF Reporter articles do treat this subject. Suffice it to say here that you'll need a wideband scope, a color-bar generator, a VTVM, a degaussing coil, extension cables, and a set of ordinary servicing and alignment tools. If you're going to be a "tough-dog" expert, you'll also want a good sweep alignment generator, a marker generator, and probably a marker adder. A VOM will come in handy for a lot of jobs and is handy to have around to back up the VTVM. There are other timesaving devices you'll pick up as you go along; but those named are rather basic.

You'll need a workbench. It should be sturdy, for color chassis aren't exactly the lightweights of the service business. It will have to be large enough to handle the biggest chassis you expect to encounter. You may even want room for two or three, in case you have to let an intermittent (heaven forbid!) cook while you work on another set. And don't forget to leave room, on the bench top or on a shelf, for your test equipment. While you won't need every piece of equipment at hand all the time, you'll find as you become proficient at color servicing that the scope and VTVM are almost indispensable. The color-bar generator will run them a close second.

Don't forget a tube caddy (an excellent stock for one is included in this issue). Unless you're set up within a larger service shop, a good proportion of your business will come through service calls. When you become a top-notch color bench technician, perhaps other service technicians will make the calls, and bring the difficult bench work to you. Meanwhile, you'll probably be making a lot of service calls. Be prepared.

That brings up the question of help. Who's going to mind the store while you're out making calls? Most one-man shops solve that problem by setting aside a portion of the day for calls and the rest for bench work. Some prefer to make their calls in the morning. One advantage in waiting till afternoon is that you can offer "same-day" service to those who call during the morning. Who takes phone calls while you're out? You could just let them go, but there are also several ways you can get them. If the distance isn't too great, you can put an extension at home so your wife can answer while you're out. If that isn't practical, the phone company offers message-taking devices at reasonable cost. Alternatively, there are secretarial answering services who will answer your phone in your absence. This latter method entails extra phone-company charges on top of the rates charged by the answering service, but often the cost is paid many times over in added service income. Get costs, evaluate the percentages, and decide for yourself.

You'll need a vehicle, although many service businesses have been started by using the family car. If that happens to be a station wagon, you've got it made! When your business gets larger, you'll want to consider a neatly lettered pickup and delivery truck; meantime, start with what you can afford, and work your way up.

If you're fortunate enough to live close to a distributor, your parts problem will be minimized. In any case, you'll have only to stock a set of tubes for the sets you're going to service, some fuses, resistors, and capacitors, and very little else. You can get most parts you'll need rather easily. If you find certain parts moving rapidly, stock one or two. But wait and let the inventory build up later. You'll need your capital now for operating and promoting your new color business.

Finding the Money

Just how much money is it going to take to get this business going? We know a chap who actually did start a color servicing shop just over a year ago, so we'll use his operation as an example.

He started with a thorough knowledge of color sets and their servicing. He had a few hundred dollars saved, and decided it was time he started his own business.

He began by evaluating his needs. He was fortunate in one respect: He worked out an arrangement with a large furniture dealer to set up shop in a back room. The rent was low; in fact, he paid only a small minimum, with the rent to increase in proportion as his business picked up.

He established his test equipment and tool requirements at approximately $1200, for he decided to purchase all new gear. He designed a workbench and a set of shelves that would fit his space, and estimated the cost at $150 for materials; he would build them himself. His tube caddy, its contents, and his initial inventory figured out to $1500. Thus, his investment capital requirements had already reached $2850.

Then he sat down and calculated how much it would cost him to run the business for six months if he had absolutely no income. (He was playing it safe, just in case.) His rent was $20 per month to start, and for an extra $5 the dealer agreed to let him put a phone extension in the dealer's office, so the office girl could answer it. So he figured a flat $25 minimum for rent. The phone itself cost $15 per month, plus $50 for installation and deposit. Utilities were furnished, so he didn't need to worry on that score. He calculated his vehicle expense at a minimum of $25 per month, knowing it would rise as business began pickup up. He figured that, if worst came to worst, he and his wife could get by on $350 per month, so he allotted that amount as his withdrawal from the business. Realizing that a new business would require quite a bit of promotion, he laid his plans and allotted $30 per month for advertising, printing, and postage.

Table 1

available from Howard W. Sams & Co., Inc.

COL-1	**Color TV Trouble Clues**	PFR Staff
TVC-1	**Color TV Training Manual**	C. P. Oliphant and Verne Ray
CSL-1	**Color TV Servicing Made Easy**	by Wayne Lemons and Carl Babcoke

Allowing an extra $20 per month for unforeseen expenses, he arrived at a total monthly operating cost of $465. For six months, with the phone expense and a $10 business license added, the total came to $2850. This represented the amount of operating capital he felt he needed to safely kick his business off.

Now he had a calculated need for about $5700. His $1600 savings wouldn't cover that, by any means. So he set about planning how to finance the venture.

He first arranged a loan to purchase the test equipment, borrowing $1000 to be secured by the equipment itself. He worked out a long-term consignment arrangement with two distributors for his entire initial inventory, under an agreement to pay monthly for all items sold during that month, plus an extra 20% which went toward converting the inventory to his own. (In this case, both distributors knew the technician well, and he had a reputation for both integrity and capability.) Eventually he would own his inventory, and for now the arrangement took care of another $1500 of his original capital needs.

At this point, he'd obtained about all the secured financing he could on the shop's assets, so he had to set about locating another $1600 to go with the $1600 he had saved. At the bank, he barely managed to raise the additional $1600 by mortgaging his car and

furniture.

Now he was just about in business. His $1600, the bank's $1600, $1000 secured by the test equipment, and $1500 advanced by the distributors in the form of inventory made the $5700 he had planned. He was in shape for opening, and open he did.

Developing New Customers

Now our hero really got things moving. He made visits to all the distributors in his area, letting them know he was in business—ready and equipped to handle color service for anyone. He dropped by some of the larger dealers, offering to handle their color service. Then he went to work on the department stores. By the end of the first month, he had developed two department-store accounts, and one dealer sent all his color work.

That was the real beginning. With some cash coming in, he began pushing for retail customers. Once a week, he took an afternoon off and personally distributed handbills, specifying color service only. The idea of calling a color "specialist" appealed to several set owners, who subsequently became customers and boosters. Business became so good, he even started taking an ad in the weekly TV supplement of his local paper.

Success

Within the first six months, the distributors' faith in him was justified; he not only paid for all the advance inventory, but purchased about $300 worth of additional parts for his working inventory. The color test equipment is now paid for, the loan on his car and furniture will soon be, and he never did have to dig into his $1600 savings. He managed the rest on earnings from his growing business.

He is definitely a successful color specialist. He had all the ingredients: a knowledge of the field, the ability to plan his operation, and the determination to carry it out. Oh, yes, he works pretty hard; he even puts in a few evenings trying to keep up when the store accounts (he has four now) and the dealers (he handles color servicing for five dealers) are having busy weeks.

But he's getting what he wanted—his own business. He'll probably be moving into his own shop one of these days, and maybe getting some help, but you can bet he'll have it all planned out before he makes the move—and that'll be a success, too.

It's a good business—color servicing. It needs hard-thinking, hard-working fellows. If you're one, you can be a specialist, too. ▲

Editor's Note: This article proved so popular the first time it appeared (November 1963 PF REPORTER), we decided to reprint it totally here. The facts are still as appropriate as they were then, except that our technician friend now keeps another full-time technician busy at color-TV servicing. In addition to a stepped-up home-servicing business, he has six store accounts instead of four, although he lost one of his dealer accounts (they started a color-servicing department of their own, spurred on by his success). He hasn't moved into a shop of his own yet; the rent is more than double, but he still gets the benefit of having the furniture-dealer's office girl answer his phone. However, he is free of debt now, and owns a new truck, plus an inventory that allows him to keep his trips to the distributor down to twice a week—and that only for special, expensive parts. The success story of this color-TV technician is certainly an inspiration to any competent serviceman.

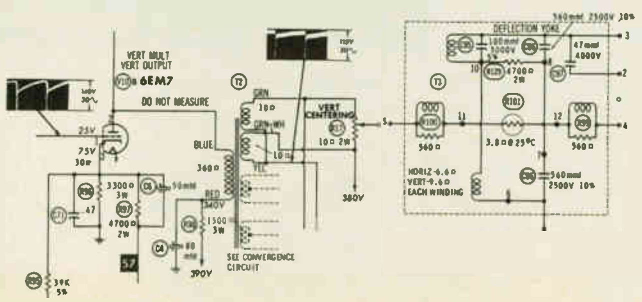
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: RCA CTC10, 11

Symptoms: Bottom of raster suddenly shrinks, with two or three inches of black showing at the bottom of the screen; in some cases raster will remain shrunken.

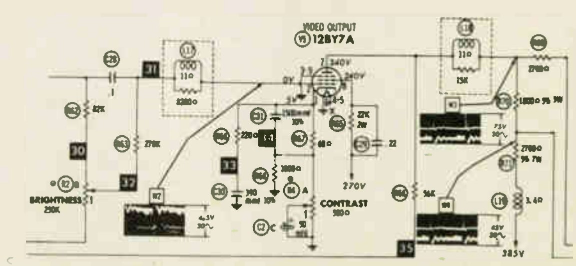
Tip: To save yourself lost time and trouble when this symptom appears, make a simple test before troubleshooting anything else in the vertical circuit: While the symptom is present, bridge electrolytic capacitor C6 (coupling capacitor to the convergence circuits) with a known good 50-mfd unit. If C6 is faulty, you'll see the vertical sweep on the CRT return to normal. The trouble might be intermittent, with the bottom edge of the raster jumping up and down; or, it might remain up. For callback insurance, replace C6 with a new unit having at least a 350-volt rating.



Chassis: RCA CTC9

Symptoms: Blooming raster; poor focus; brightness control has little effect.

Tip: Before looking for trouble in the horizontal and high-voltage circuits, measure the plate voltage of the 12BY7A video output tube. You may find it approximately 100 volts low. If you do, check R71—the 2700-ohm, 7-watt plate resistor. This component has increased in value in some of these chassis, shifting the cathode voltage on the CRT. This causes the CRT current to increase, overloading the high-voltage supply. These symptoms could be misleading, for if you measure the high voltage you'll find it lowered to approximately 19 kv, while it should be 23.5 kv.



COLOR TUBE STOCK CHART

The following chart of tube types and suggested stock covers the tubes shared or used only by color-TV receivers. Those types marked with an asterisk (*) are used mostly in early color sets of several different brands and model numbers.

The chart is divided into two parts; the second part lists the new types introduced in '65 TV models. The manufacturers using the types listed are shown as an aid to inventory decisions. The chart also lists tubes used in remote control units for color receivers.

TUBE TYPE	SHELF STOCK	CADDY STOCK
1AU2	1	1
1V2	2	1
1X2B*	2	1
3A3	1	2
3AT2	1	1
3DG4	2	1
3DT6	1	1
4BL8	1	1
4HA5	1	1
5U4GB*	8	3
6AF4B	2	1
6AG7*	1	1
6AL5	2	1
6AL11	1	1
6AN8*	1	1
6AQ5	3	3
6AU4GTA	2	2
6AU6A	3	2
6AU8A	1	1
6AV6	2	2
6AW8A	3	2
6AZ8*	1	1
6BA11	1	1
6BC8	1	1
6BE3	2	1
6BH11	1	1
6BK4	2	1
6BL8	2	2
6BM8	1	1
6BN6	3	1
6BN8	1	1
6BQ5	3	2
6BQ7A*	2	1
6BY6*	1	1
6BZ6	8	4
6C4	1	1
6CB5*	1	1
6CB6*	3	3
6CG7	6	2
6CG8A	5	2
6CL6*	1	1
6CN7	1	1
6CQ8	1	1
6CS6	2	1
6CW4	1	1
6CW5	2	1
6DE6*	2	1
6DK6	2	2
6DQ5	2	1
6DQ6B	5	3
6DS4	2	2
6DT6A	2	2
6DV4	1	1
6DW4	1	1
6DX8	1	1
6EA8	3	2
6EH7	3	2
6EJ7	3	2
6EM7	2	2
6EV7	1	1
6EW6	2	2
6EZ5	1	1
6FG7	2	1
6FH5	1	1
6FM7	2	1
6FQ7	5	2
6GC5	1	1
6GF7	3	2
6GH8A	3	2
6GJ7	1	1
6GK5	3	2
6GL7	1	1
6GM6	3	2
6GU7	3	2
6GX6	2	1
6GY6	1	1
6HA5	1	1
6HB6	2	1
6HE5	3	2
6HF5	3	2
6HL8	1	1
6HS8	2	1
6HZ6	1	1
6JC6	2	1
6JE6	3	2
6JH6	3	2
6JH8	3	2
6JT8	1	1
6JU8	3	2
6KA8	1	1
6KT8	1	1
6KZ8	1	1
6SN7GTB*	2	1
6T8*	1	1
6U8A	1	2
6U10	1	2
6X8A*	2	2
7GU7*	2	2
12AT7	1	1
12AX7	2	1
12AZ7A	1	1
12BH7A	2	2
12BY7A	2	1
12GC6	1	1
12GN7	1	1
15CW5	2	1
15DQ8	1	1
15HB6	2	1
15LE8	1	1
16A8	1	1
19AU4GTA	1	1

NEW TYPES INTRODUCED IN '65 TV

4AF4A	GE
6HB7	Airline Magnavox
6HQ5	Airline Andrea
6JM6	GE Motorola Zenith
6JN6	Zenith
6KL8	Airline Ambassador
8GM6	RCA

*Used in early color receivers (CTC4, CTC5)

EICO's complete new color TV lab for the pro

A.

Model 380

B.

Model 369

C.

Model 435

Color TV servicing is a job for professionals—and **Eico's new color TV test equipment** is designed to their requirements. Professional service engineers can't afford to waste time on apparent set troubles caused by make-shift, inaccurate test signals, or on test equipment that is inherently difficult to use or incapable of fast, accurate determinations. Critical professionals know they can depend on EICO for accuracy, reliability, and laboratory standard performance. Moreover, EICO has now successfully reduced equipment size while improving performance, to permit convenient on-location servicing. No wonder the pros choose EICO!

PROFESSIONAL PERFORMANCE IN COLOR TV TEST INSTRUMENTS/ (A) MODEL 380 SOLID STATE N.T.S.C. STANDARD COLOR SIGNAL & DOT-BAR GENERATOR (PAT. PEND.) Entirely unique in both providing completely standard 100% fully saturated N.T.S.C. color signals, including both chrominance and luminance signals exactly as specified, and in being **completely transistorized.** Color burst is precisely gated and delayed according to N.T.S.C. standards, and phase angles are permanently established by taps on a linearly distributed delay line, so that no adjustments are ever required. Use of saturated transistor for switching and delay provides square "clean" waveforms without significant overshoots or ringing for excellent signal definition. The design of the 380 is an absolute protection against obsolescence, and assures the professional service engineer that apparent set trouble is not caused by a non-standard test signal. In addition to **generating 11 different color signals, one at a time,** for hue and demodulator adjustments, the Model 380 generates dots, crosshatch, horizontal lines, and vertical lines for convergence and linearity adjustments. Both video and RF outputs are provided, with gain controls. Three crystal-controlled oscillators are employed for color burst and color information, convergence and sync signals, and RF output on TV channel 3 **no drift or waiting for warm-up.** Entirely stable and inherently rugged by solid state design, the Model 380 is also **outstandingly compact** and weighs only 4 lbs. SIZE (HWD): 8½ x 5¾ x 6⅜ inches. Kit **$109.95.** Wired **$159.95.**

(B) MODEL 369 TV-FM SWEEP & POST-INJECTION MARKER GENERATOR (CRYSTAL-CALIBRATED) For easiest, fastest visual alignment of color or B&W TV, and FM receiver RF & IF circuits. Five sweep ranges from 3-220 mc and four marker ranges from 2-225 mc, plus a crystal marker oscillator that turns on when a crystal is plugged into the panel socket (4.5 mc crystal supplied for TV sound alignment). Controllable inductor sweep circuit is purely electronic and has no mechanical parts to wear out. Retrace blanking, and a 3-stage AGC circuit for a constant amplitude of the swept signal even when the widest sweep width of 20 mc is used. With the 369, circuit response is not affected by markers and markers are not affected by traps in the circuit. Only the sweep signal is applied to the circuit under test. A demodulator cable picks up the output signal and feeds the demodulated signal to a mixer stage in the 369 where the markers are added, then the combined signal is led to a 'scope. Separate trace size and marker size controls can be used independently. SIZE (HWD): 8½ x 12½ x 7½ inches. Kit **$89.95.** Wired **$139.95.**

(C) MODEL 435 DC WIDEBAND 3" OSCILLOSCOPE You'll be able to complete many more color or B&W TV service calls on location if you can take your 'scope with you. EICO's 435 is really **portable** (⅓ the size of conventional 5" scopes) and fully equipped to do the job. Quality equal to or better than the finest 5" TV service scopes is achieved with a **far sharper, brighter trace** on a flat-face CRT. Direct-coupled, push-pull V amplifier, with 4-pos. frequency-compensated decade attenuator has no low frequency phase shift, and **is flat from DC—4.5mc** (+1, —3db). Far more accurate p-p voltage measurements than ever before with a **Zener diode-controlled square wave calibrating voltage,** and an **edge-lit calibration grid.** Easier to use for TV servicing with pre-set TV-V and TV-H positions in addition to 4 sweep ranges, **automatic sync** limiter and amplifier, and **full retrace blanking.** Amazingly easy to build because of professional interior packaging that has eliminated crowding and permits easy access to any component. SIZE (HWD): 8½ x 5¾ x 12⅝ inches. Kit **$99.95.** Wired **$149.95.**

ONE MORE MATCHING INSTRUMENT EQUIPS YOU FOR FM STEREO SERVICING MODEL 342 FM MULTIPLEX SIGNAL GENERATOR. The EICO Model 342 is a compact, efficient instrument essential for test or alignment of the multiplex circuits of FM Multiplex Stereo tuners, receivers, and radios. FM Stereo is a field as fast-growing as color TV, and a multiplex generator is an absolute must for getting a share of the increasingly important and profitable service business. The circuitry of the Model 342 is of the design lab quality needed for restoring original performance quality to the costliest equipment, but the controls have been simplified for fast, uncomplicated operation. With it, you can quickly measure and adjust channel separation and balance, or the input level needed for synchronization or switch-over to stereo operation. The Model 342 provides signals as perfect as those available from generators costing many hundreds of dollars. It provides both a controlled amplitude composite audio output for direct signal injection beyond the detector into a multiplex section, and the same signal modulating an FM RF carrier at about 100mc (adjustable) with controlled deviation ± 75kc (100% modulation) for connection directly to the antenna terminals. Either a built-in 1kc oscillator (below 0.3% distortion) or an external audio oscillator may be used to provide the left only, right only, difference, or sum signals. **The 19kc pilot signal is crystal controlled** and may be switched on or off independently of the composite signal. The signal may be obtained without audio information and only the 19kc pilot injected. An oscilloscope sync output is provided, with a choice of either 19kc sync or internal 1kc/external oscillator sync. In addition, an input is provided for connecting an external audio oscillator to provide an SCA signal when required. Another important and valuable **feature of the Model 342 is dual inputs and amplifiers for a stereo source to permit FM MULTIPLEX STEREO demonstrations to customers when there are no stereo programs being broadcast.** Modern compactron tubes are used to obtain a lightweight, compact package that is easily portable. SIZE (HWD): 8½ x 5¾ x 12½ inches. Kit $99.95. Wired $149.95

Visit the EICO exhibit in the Pavilion of American Interiors at the World's Fair

EICO ELECTRONIC INSTRUMENT CO., INC.,
131-01 39th AVENUE, FLUSHING, N.Y. 11352

SEND 1965 CATALOG LISTING 230 EICO PRODUCTS.

NAME ____________________

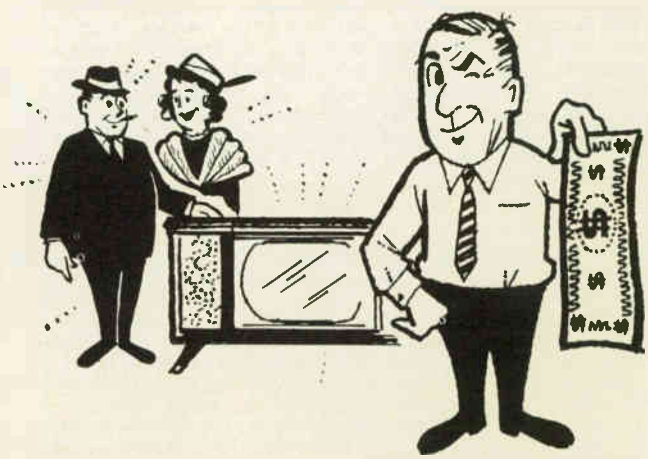
ADDRESS ____________________

CITY __________ **STATE** __________ **ZIP** ______

selling color TV

Turning those three basic colors into green . . . the long kind.

by Art Margolis



I'd say that out of every hundred house calls I make, there are 75 people who ask me, "What's the best color TV?"

What is your answer to this question? Do you snort, "There is no good color TV," or do you say, "Stick to your major brands, but be careful—the service is murder," or do you hem and haw, "Well, I'll tell you, RCA has been at it the longest, Zenith has some new demod circuits, Motorola has the square picture tube, ... "

Don't laugh, I've heard variations of these answers from TV servicemen. They are obviously all the wrong things to say if you are going to convert that leading question into a new color TV sale and maybe a rotor antenna sale, etc.

Our response to that and similar questions has been worked out over a long period of time and many color TV sales. Let me show you how we take the customer's interest in color TV and convert it to dollars and sense in the next three sales case histories.

Case of the Husky Hairdresser

I only knew Jacque by sight until he called for service. He looked more like a professional football player than a woman's hairdresser. He met me at the door with a big smile and told me, "This is the first service call I've had on this TV in five years." I nodded and turned on the 21″ TV. It looked like it hadn't been serviced in five years. The picture took a good two or three minutes to come on. When it finally did show a little light, it was rolling, shrunken on the sides, and it had the bends, some snow, and muffled audio.

I began assessing the repairs necessary to restore this TV to peak performance. I tapped around the tubes. The damper arced a little, the 6BQ6 cap was loose, and the 6U8 local oscillator was shining too brightly. I figured at least six tubes needed replacement. The bend, however, was not tube trouble; the shrinking was four-sided, and the CRT never did come up to normal brightness levels. The set was in bad shape.

I said, "You'll need quite a bit of work on the TV."

"About how much?"

"I figure the set will need several small tubes, a new picture tube, and a complete overhaul. Looks like at least $50 worth, maybe as high as $60. I can't tell for sure until I get it on the bench."

Jacque developed a sickly look on his face and asked, "How long will it take?"

"You had better figure on the better part of a week. I'd like to keep the set a couple of days after the repairs have been made in order to check their accuracy."

"Gee, the kids are going to be lost without a TV. Any chance of loaning me a set while you're working on it?"

I was waiting for that question. "I'll tell you what; I have a 'loaner' in the truck. Help me carry it in."

He grinned. We carried his TV out, put it in the truck, and carried a large metal 21″ table model back into the house. I screwed some legs into the bottom of the set, hooked up his antenna, and turned it on.

He exclaimed, "Hey, that's a color TV."

I pretended to apologize, "I'm sorry but that's the only loaner I have left with me."

As I left I heard him say, "Man, look at the color of that redhead's hair."

It wasn't more than an hour later when the phone in the shop jangled and I heard a frantic Jacque, "Art, did you start on my TV yet?"

"No, Jacque, I didn't, but I'll get to it today."

The frantic tone left his voice. "Good," he breathed in relief. "I really flipped over this color TV. I've never seen one in operation before. How much it it?"

I said, "That model goes for $400."

He asked, "Is mine worth anything on a trade-in?"

"To be frank, not too much in its present condition. It needs a great deal of work. I can let you have a few dollars for it though."

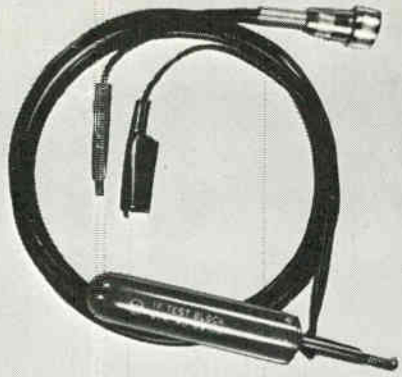
He said, "Work me out a deal and call me back."

I said, "You don't want that loaner, it's used. Stop in the store—I'll be here for the next couple of hours—and we can go through our stock and catalogs. You can keep the loaner until we get you a new one."

The rest of the sale and writing the finance papers were routine. Jacque picked out a color TV for $695 and decided to repair his old TV for a second set. I included the repair in the finance papers too.

The only complication happened that night when I arrived home. I asked my wife, "How come you dyed your hair red?"

She answered, "It's not my hair. It's a fashion wig. Jacque loaned it to me on approval. Only $99—isn't it a honey?"



RCA TV Alignment Probes

Bandpass analysis should be part of your regular service technique—pinpoint faulty circuits accurately and rapidly with these five alignment aids:

Video Detector Test Block—8B105
IF Test Block—8B106
Sound Detector Test Block—8B107
Mixer Grid Matching Pad—8B108
Tuner IF Input Head—8B109

For all RCA TV receivers and most other makes of color TV receivers.

RCA Deflection Cables

Extends yoke cable when any RCA Victor color chassis is removed from cabinet for servicing.

RCA High Voltage Extension Cables

Extends kinescope high voltage lead when 212 Series color chassis is removed. 13A100.

RCA Degaussing Coil

Demagnetizes color kinescope and chassis. Available with or without momentary switch. Includes 110V power cord and plug. 205W1; 205W2 (with switch).

PROFIT WITH RCA COLOR PARTS AND ACCESSORIES

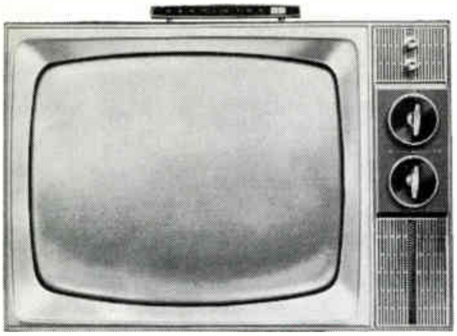
make your servicing faster, easier, more accurate

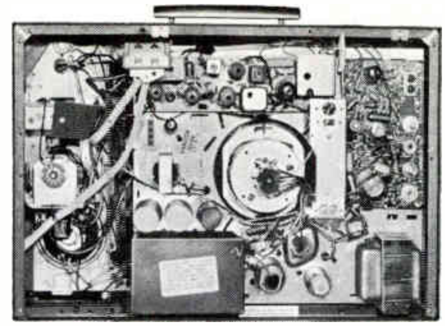
RCA Color Parts Rack

Complete, self-contained space-saving service center. Contains 119 essential parts and accessories for servicing CTC-10, 11, 12, 15 and 16 chassis. Can be mounted on wall or service workbench. 11A1014.

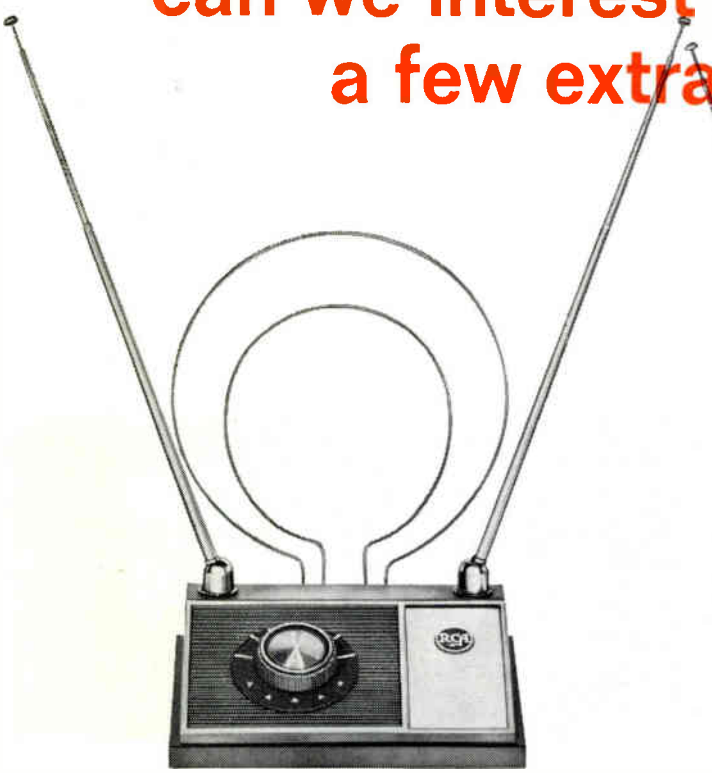
See the complete line of RCA accessories, equipment and replacement parts at your RCA Parts and Accessories Distributor.

If you sell or service TV sets





can we interest you in making a few extra dollars?



New RCA Stratomaster—
for both VHF and UHF channels.

New RCA Stratoscope—
for VHF channels only.

If you're in the TV business, why not include these two natural profit makers in your line? These RCA indoor TV antennas are styled so smartly they virtually sell themselves. And they work so well they keep customers sold on you!

SMART STYLING. An instant selling point. The first indoor antennas you can recommend with pride as a decorative asset to any interior.

EXCELLENT PERFORMANCE. These RCA indoor antennas are designed by the same RCA engineers who develop antennas for satellites and space. They include (a) an automatic signal-phasing device to pull in the strongest, sharpest picture possible with an indoor antenna, (b) a channel selector switch to block out ghosts and interference, (c) super-fine tuning, (d) telescoping 45-inch arms turnable in any direction without moving the base.

and they're advertised nationally in POST and TV GUIDE

for immediate customer recognition and acceptance.

ORDER FROM YOUR RCA DISTRIBUTOR. AND HURRY... SO YOU'LL HAVE THEM IN STOCK WHEN CUSTOMERS START ASKING FOR THEM.

RCA PARTS AND ACCESSORIES, DEPTFORD, N. J.

RCA **The Most Trusted Name in Electronics**

Here is a real "must" for anyone servicing or planning to service color TV sets.

No longer must you send two men to a customer's home to pull in his entire color set. Now, one man can simply remove the chassis and bring it back to your shop for testing, troubleshooting and alignment in your RCA Color TV Test Jig.

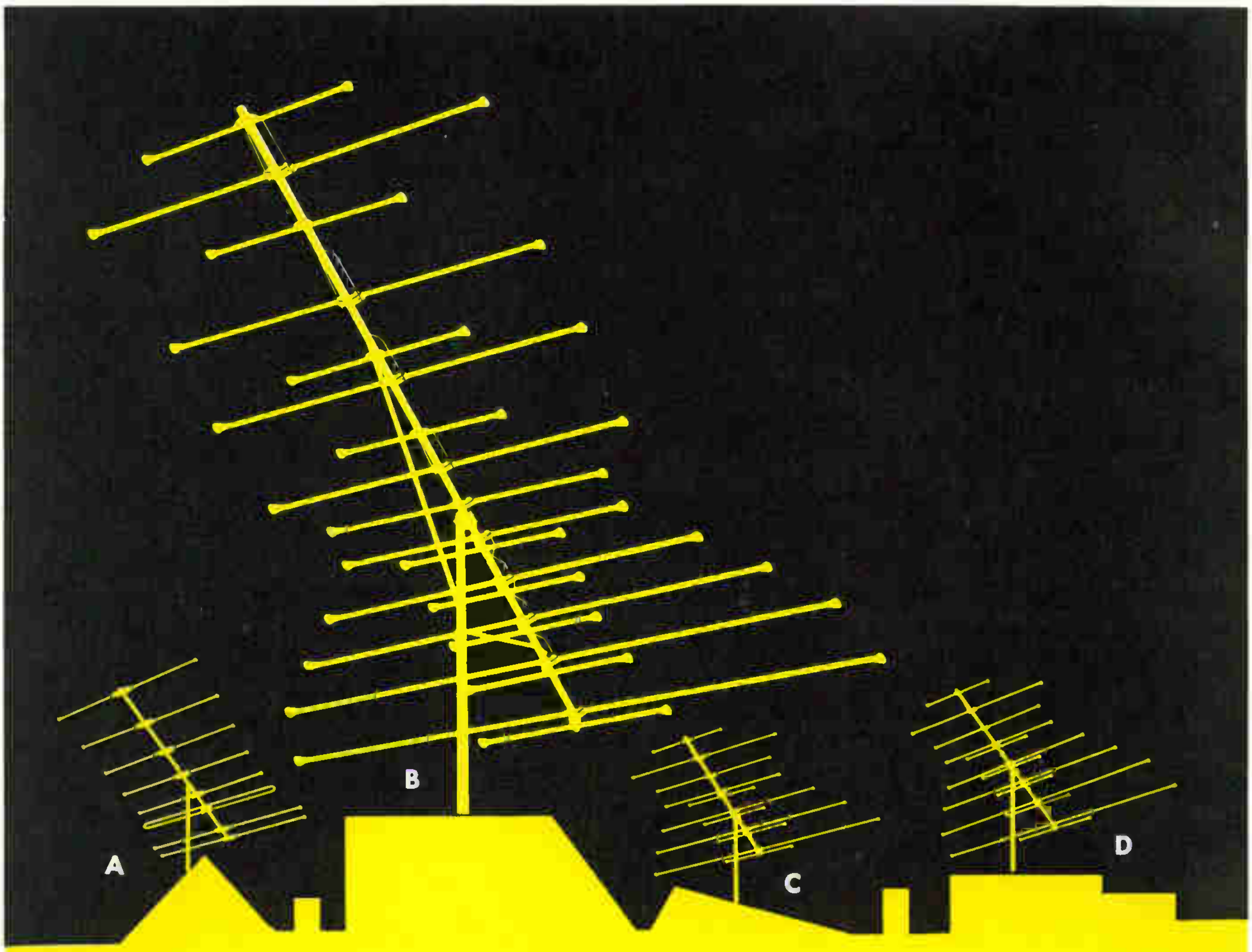
Look at some of the extra advantages built into this money-saving unit:

- **Minimizes costly damage claims.** Pulling chassis eliminates possibility of scratching or damaging a customer's cabinet when transporting it to and from his home.
- **Saves time.** Eliminates need to reconverge a customer's set when chassis is returned. Convergence control panel on Test Jig provides static and dynamic convergence.
- **Versatile.** Can be used with all RCA color chassis.
- **Safe.** Supplied with factory-installed safety glass and kine mask.
- **Complete components kit,** supplied with unit, provides all necessary service components and instructions for installing RCA Color Picture Tube.
- **Professional appearance.** Finish matches that of your other RCA test instruments.

The RCA Color TV Test Jig is available through your Authorized RCA Parts and Accessories Distributor. See him this week to find out how this versatile instrument can help you capitalize on the growing Color TV servicing market.

RCA PARTS AND ACCESSORIES, DEPTFORD, N.J.

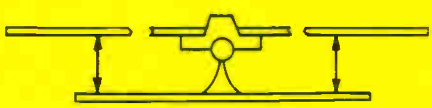
RCA THE MOST TRUSTED NAME IN ELECTRONICS



RCA OUTDOOR ANTENNAS

the name . . . the features . . . the line that sells

Now you can select the best model for your customer's location from this new RCA outdoor antenna line that combines all-channel yagi and multiple cross-driven types. Satisfy them with the sharpest color and black-and-white pictures.



CAPACITIVELY COUPLED

Explain the RCA *exclusive* feature in customer language. Only RCA antennas feed energy directly into the transmission line from low band driven elements. These are capacitively coupled, positioned directly above high band driven elements. RCA, of course, phases low and high band directors for best high band performance.

In addition, RCA's electro-lens director system absorbs maximum incoming signal power, gives extremely high gain across the VHF band, offers excellent forward gain on the front end.

More customer interest! A gold anodized finish protects every RCA antenna from weather corrosion. Wrap-around mast clamp aligns antenna on mast, prevents boom crushing.

Just call your RCA Victor distributor. Look at and learn about RCA 200, 300, 400 antennas . . . from the color TV pioneer! From there on . . . sell!

A. RCA 500 FM antenna. Eight-element yagi. Acute directivity. 88 to 108 MC. VSWR 1.25:1. Average eight db gain.

B. RCA 400 antenna. 19 elements, for fringe area or distant reception.

C. RCA 200 antenna. 11 elements, for local reception.

D. RCA 300 antenna. 13 elements, for suburban and near fringe area locations.

RCA PARTS AND ACCESSORIES, CAMDEN, N.J.

THE MOST TRUSTED NAME IN ELECTRONICS

The Mystery of the Snowbound TV

A no-nonsense female voice snapped out of the telephone, "Do you rent TV's?"

I answered, "Yes, ma'm, we do."

She continued, "OK then, come pick up my TV for repairs and bring me out a nice 21" TV to watch."

I asked, "Are you sure we can't repair your TV in the house?"

She answered, "I'm sure. The TV is full of snow."

I said, "Well that doesn't sound too serious, it might be just a tuner tube or a broken antenna wire."

She snapped, "You're welcome to try, but I know the TV is going to need shop work. It's not the antenna, because you installed a new one for me just last month. This is Mrs. Day!"

I remembered. These people would have no problems in paying the bill. Her old antenna had blown down after ten years and had been lying in the yard when I arrived. The service order had requested that I put it back up, but the old materials were shot. I told her, "Your antenna is rusted away and the twin lead is worn out. I'll have to put up a new antenna system."

She agreed on a $100 installation after I told her she'd be all set for color when and if she decided to purchase one.

As the previous service call went through my mind, I seized on this ideal situation. "Mrs. Day," I said, "since you need a loaner, I'm going to bring you out a very special one."

She said, "Just be quick about it."

I remembered she had white French provincial furniture. Her old TV was also in the same decor. I had an expensive set in stock that matched her living room perfectly. I loaded it on the truck.

I drove to her house; a teenager let me in, and I had the TV installed by the time she knew I was there.

She snorted, "Very shrewd, but I'll let you take it back with you when you return my TV."

I smiled charmingly, "It'll be my pleasure, Mrs. Day."

Another teenager entered and began to ooh and ah. A cooking show came on in color. The background was bright blue. Mrs. Day softened, "Well, Art, you really are something bringing that beautiful TV out here."

I said positively, "You'll never let me take it out after it's here a few days."

She repeated, "You really are something."

I said, "Incidentally, there is no rental charge on this. I thought you'd like to take advantage of our free home demonstration."

She stood there and smiled at me.

I asked, "Where's your TV? I want to check out the snow condition."

She said, "It's in the yard." She led me to the back door. I laughed to myself. It had a snow condition all right. The power transformer had been burning, so they put the set outside and left it there overnight. It was all filled with white cold stuff, as the yard was.

Of course, she kept the color TV. We dried out her old TV and replaced the power transformer; we then sold Mrs. Day's TV as a used set.

The Discount Addict

I recognized the tall, thin fellow in his early 30's who sidled into the shop the other afternoon. He had been a customer for years. He said confidentially, "Hey Art, I want a color TV." This was too easy; he was the type who was always asking for discounts on parts and labor.

I smiled. He continued, "Here's the model number." He handed me a card. It was a calling card and had the name of a salesman from a nearby discount house. On the back was written the model number of a famous make color TV and a price of $365."

I asked innocently, "What about it?"

He answered, "I was in the discount house and the salesman showed me this model at that price. It includes free delivery and a year's guarantee."

I recognized the model as a leader item. They are always "out of stock." I asked, "Did you tell him you were going shopping?"

He nodded. I took a deep breath, then began, "I'd like to compete with this price, but I can't. As you know we are primarily a service organization not a sales-only company. That way when you buy from us, you're buying our services as well as the color TV. It's like buying a custom installation in comparison to an assemblyline job. I personally will deliver the TV, make sure that it's installed properly, that the room lighting is correct, that the TV is adjusted perfectly, and that your antenna system is delivering good color. If you should need service or advice you can get me anytime, and I'll be there within an hour."

He nodded, "Yeh, Art, I know all that, but can you get me this price?"

I looked at the model again. "Well, I'll tell you, this price is not bad. It's a leader model, you know."

He said firmly, "Yeh, I know, but what will it cost from you?"

I paused then said quizzically, "Are you sure you want this model?"

He said, "Yeh, I'm sure." Then he asked, worried, "What's wrong with this model?"

I said, "Nothing. It's an excellent TV, only it doesn't have a degaussing coil."

"A what?"

"You know, the degaussing coil. If the colors mess up due to the magnetic field of the earth, you press the button on the coil instead of calling for service."

"Really?"

I nodded, then went on, "Another thing, before you let them send the TV out, make sure they check it out and play it for a few hours in their shop."

"What do you mean?" He said, "I'm gonna get a new one in a sealed carton."

I shook my head and shrugged.

He said earnestly, "I don't understand, Art."

I told him, "Well, it's been our experience that if you open up ten color TV cartons and turn on the sets, you'll get ten different pictures. It's not like black and white. Some of the pictures are blue and white or pink and white or almost anything. Sometimes there are broken tubes in the set or other problems. We won't deliver a color TV in a sealed carton; we deliver it minus the carton, all checked out and ready to watch."

I don't think this type of talk is unethical. It's simply a matter of pointing out the advantages of our service over the discount operation.

He thanked me and left. About an hour later he was back with his wife. He muttered, "He was out of stock on that model and tried to sell us a more expensive job. I'd just as soon buy it from you and get the same type of service you've been giving me for years."

We sat down, and they picked out a color TV for $495. They have been happy with it ever since and have talked a few of their neighbors into color sets from us too. Which reminds me, I should send them a clock radio or something as a token of my thanks for the business they shuttled my way.

Conclusion

Selling color TV is a natural adjunct to our service business. The service company is the one to handle the touchy color TV from carton to viewing in the home. Why shouldn't they share in some of the sales too? All it takes is some salesmanship. The same kind you use to sell a picture tube or extensive troubleshooting job.

We can't sell everybody. We can't even dent the large volume of sales that department stores and discount houses enjoy. However, we can grab enough of the sales to boost our weekly profits in a pleasant fashion.

There are plenty of opportunities. When people want loaners or rentals, and they look good, install a color TV in their house. When a discount buyer gives you a chance to bid, point out artfully the advantages of personalized service. You won't always score, but you will get enough in the flourishing color TV market to keep you hopping. ▲

COLOR TV FORECAST

by Albert Warren, *Television Digest*

According to a survey of manufacturing and network executives conducted by Television Digest, our weekly industry newsletter, more than 23,000,000 homes will have color sets by the end of 1970, and such receivers will be selling at the rate of 5,000,000 annually at that time.

Responses by 14 industry leaders, including the makers of virtually all TV receivers, plus network spokesmen, showed remarkable agreement in their forecasts. Now that color set sales have achieved a broad-based breakthrough, the industry has reached an unusual uniformity in its projections. Here's how the survey results were reported in the March 22, 1965, issue of Television Digest:

Color, now becoming important factor in TV, will accelerate its penetration into American's homes for remainder of decade; it will be in 50% of nation's TV househoids by early in the 1970's.

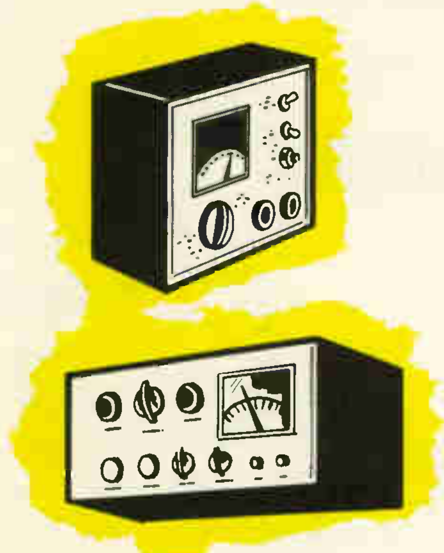
This is virtually unanimous view of industry leaders who participated in our annual survey of color TV's growth. Based on premise that there were 2,860,000 color sets in use as of Dec. 21, 1964 (NBC Research estimate), representing about 5.4% of TV households, industry sees color homes increasing by 71% this year to 4.9 million, representing 9.2% of TV homes.

Within 6 years, by end of 1970, survey's respondents envision 23,330,000 color sets in use, equivalent to 40% of anticipated total TV homes. By end of next year, some 13.8% of TV homes should have color. After that, and through 1970, color saturation will increase by about 6 percentage points a year. Through end of 1970, increases should continue to be huge, and even in 1970, color-sets-in-use figure is seen as rising 24% in single year.

Since most respondents were manufacturers, reply data presumably takes into consideration anticipated trends in receiver pricing, technological developments, etc. Respondents were specifically requested to take set scrappage into consideration, and actual anticipated annual sales are higher than each year's increment.

Respondents to this year's survey were in greater agreement than in last year's sampling. Estimates, in fact, were surprisingly close to one another. Almost all respondents revised their estimates upward as compared with year ago.

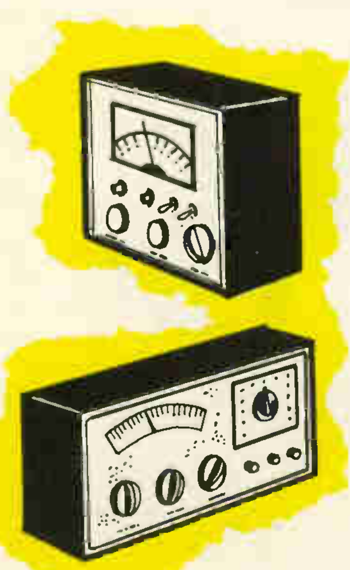
DATE	COLOR SETS IN USE	TOTAL TV HOMES	COLOR SATURATION	INCREASE OVER YEAR EARLIER
Dec. 31, 1964	2,860,000	53,100,000	5.4%	77%
Dec. 31, 1965	4,900,000	53,500,000	9.2%	71%
Dec. 31, 1966	7,670,000	54,300,000	14.1%	56%
Dec. 31, 1967	10,970,000	55,200,000	19.9%	43%
Dec. 31, 1968	14,770,000	56,200,000	26.3%	35%
Dec. 31, 1969	18,850,000	57,300,000	32.9%	28%
Dec. 31, 1970	23,330,000	58,300,000	40.0%	24%



are you equipped for color?

Instruments & tools for servicing.

by Robert G. Middleton



Color - TV troubleshooting and maintenance require several specially designed test instruments in addition to those used in black-and-white TV service. Convergence of a color picture tube can be accomplished satisfactorily only with the aid of a white-dot or crosshatch generator. Chroma-circuit adjustments cannot be made accurately unless some type of color-signal generator is used. Troubleshooting of chroma-circuit defects is not entirely practical without a wide-band scope to check waveforms for distortion and peak-to-peak voltages. Alignment of all signal circuits entails a suitable sweep and marker generator. Frequency coverage and marking facilities must be appropriate to chroma-circuit characteristics. Trouble localization and pinpointing of component defects is facilitated by use of color-TV analyzers.

Individual instruments are available to generate white-dot and crosshatch signals, although the industry trend is to provide both functions in the same instrument. Various color-signal generators also provide white-dot and crosshatch outputs. In addition, some generators supply a shading-bar signal to facilitate adjustment of the color picture tube. Dot output is generally preferred for static convergence, while crosshatch output is commonly used in dynamic convergence procedures (Fig. 1). Many technicians claim they find dynamic adjustments easier if the crosshatch pattern can be broken down into the vertical and horizontal lines—a facility provided by many generators. Personal preferences vary concerning dot size, and some generators offer a dot-size control.

Convergence pattern generators in the low-price bracket, while often supplying dot, crosshatch, vertical-line and horizontal-line signals, may supply video-frequency output only and require an external sync connection. Although the end result is the same insofar as convergence procedures are concerned, some technicians prefer a modulated-RF output that can be applied directly to the antenna input terminals of the color receiver. Others who are experienced in connecting the generator into the video circuitry do not feel that the lack of modulated-RF output is a disadvantage.

Note: Material in this article adapted from the Howard W. Sams book "Know Your Color-TV Equipment" by Robert G. Middleton.

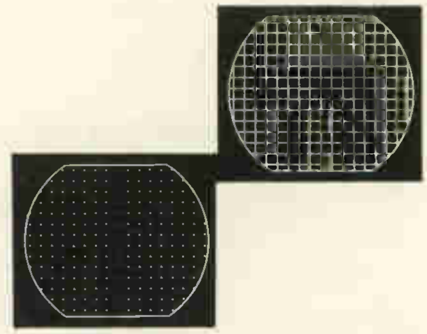


Fig. 1. Dot and crosshatch patterns.

Color Generators

Various types of color-pattern and color-bar generators are in everyday use. Some of these generators are quite simple, while others are fairly complex. The simplest type is called the unkeyed-rainbow or color-display generator. It supplies an offset color-subcarrier signal, which is also called a sidelock signal or a linear phase sweep. A "rainbow" spectrum of color-difference hues is displayed on the screen of a color picture tube. This display should not be confused with a conventional rainbow spectrum, since the colors and their sequence are somewhat different. A typical service-type color - bar generator is shown in Fig. 2.

Unkeyed Rainbow Generator

Simplified convergence - pattern generators sometimes have a basic color-signal output, consisting of an unkeyed-rainbow display or a single-bar signal at burst phase (Fig. 3). Availability of a basic color signal provides useful test data, although

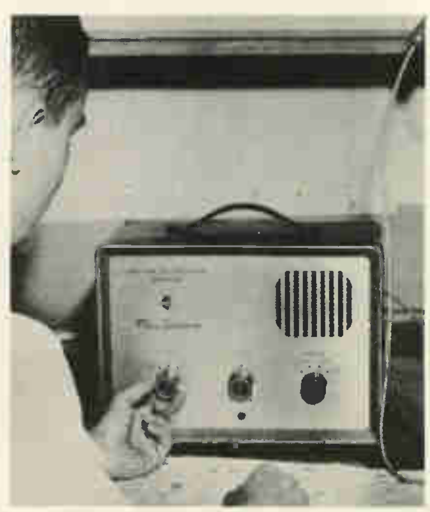


Fig. 2. Service color-bar generator.

bench work generally requires a choice or array of color-bar signals. An unkeyed-rainbow generator tends to complicate chroma-circuit troubleshooting and adjustments due to lack of chroma marker facilities. This term refers to marking phase, rather than frequency. A burst-phase bar generator also tends to complicate bench work in that the pattern must be interpreted with respect to the chroma circuit under test. Nevertheless, considerations of cost may outweigh operating convenience.

Keyed Rainbow Generator

Keyed-rainbow generators are more elaborate than simple generators in that the rainbow signal is switched off and on as required to display rainbow color bars on the picture-tube screen. Ten bars are displayed, as depicted in Fig. 4. A definite advantage of the keyed display is the fact that chroma phases are identified at 30° intervals by the

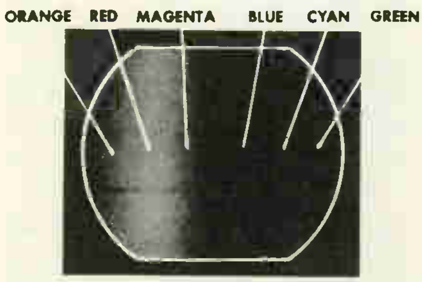


Fig. 3. A simple rainbow pattern.

rainbow bars. This feature makes it much easier to analyze the pattern for defective reproduction, and it also facilitates scope waveform analysis when troubleshooting the chroma circuitry in a color receiver.

The other type of color-bar generator is called the NTSC type, which provides fully saturated color-bar signals. These signals comprise the primary and complementary colors with black and white reference levels. The color bars may be displayed as six simultaneous bars, or each color bar may be displayed individually by some instruments (Fig. 5). Practically all generators in this classification supply individual R-Y, B-Y, and G-Y bars, and some also provide individual I and Q bars plus a G-Y /90° signal.

There is also an intermediate class of color-bar generator which provides keyed-rainbow bars with adjustable pedestal signals. This type of generator gives somewhat more data than a simple keyed-

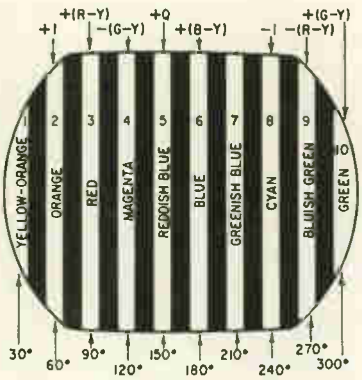


Fig. 4. Keyed-rainbow test pattern.

rainbow generator, but unlike an NTSC generator, it does not provide standard hues and saturations "across the board." Many technicians state that a keyed-rainbow signal is sufficient for all chroma tests; others prefer the NTSC signal, since it provides controllable versions of basic color-station signals.

Compactness and portability, as well as cost, can often be a deciding factor in the choice of generators. A shop may prefer a light and compact instrument for service in the home, but maintain an elaborate and comparatively bulky NTSC instrument for bench work. The extensive choice of specialized signals available from a large NTSC generator is sometimes stressed as an advantage in analysis of defective chroma circuits. Comparatively compact NTSC generators that are as portable as keyed-rainbow generators are available. While these lack various specialized outputs, they serve their purpose on home service calls.

Color-TV Analyzer

An offspring of the color-bar generator is called the color-TV analyzer, or flying-spot scanner depending on the supplementary junctions which are provided. These instruments not only supply video-frequency and modulated-RF color bars, but they also have RF and IF outputs suitable for signal injection

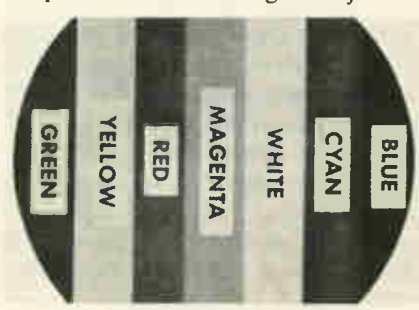


Fig. 5. Pattern for NTSC generator.

at any stage in a receiver. A typical analyzer provides a keyed-rainbow pattern, white dots, test pattern, crosshatch, vertical bars, horizontal bars, and shading bars, as well as sync, sound, and audio test signals at controllable levels for injection into receiver circuitry. Clamping bias, gun-killers, and a deconvergence control are often available also in this type of instrument.

Pulses are generated by a photomultiplier tube from light passing through a scanned transparency. These video pulses are combined with horizontal and vertical sync pulses and modulated on an RF carrier. Various transparencies can be inserted into the generator, which provides a wide choice of patterns. Fig. 6 illustrates an example of this flexibility, in which white dots are included in a crosshatch pattern. This type of generator does not employ counter circuits.

Since counter circuits are not

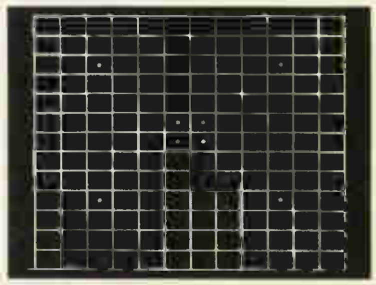


Fig. 6. Crosshatch pattern with dots, displayed by a flying-spot scanner.

used in the sync section, scanning is not interlaced. However, this does not impair the utility of the white-dot and crosshatch patterns. Vertical sync pulses are locked to the power-line frequency and derived from a neon relaxation oscillator. Horizontal sync pulses are referenced to a 15,750-cps ringing coil. The ringing coil is provided with a tuning slug for maintenance adjustment.

Analyzer Functions

Although a flying-spot scanner provides white-dot and crosshatch patterns, various other output signals have considerable utility in color-TV service. For example, a scanner designed for color work has a rainbow-pattern oscillator and a 4.5-mc oscillator, which may be switched into the modulator circuit. These signals make a scanner generator the equivalent of combination rainbow- and convergence-pattern generators. Many scanner generators also provide IF, video, sync, and sweep output signals, and these elaborated instruments are called color-TV analyzers.

The video-signal output can be used to make signal-injection tests in receiver circuits. This is a composite video signal consisting of the camera signal, horizontal sync pulses, and vertical sync pulses. Since the video detector in a TV receiver may be polarized either positive or negative, it is essential that the generator provide a choice of signal polarity. Furthermore, the signal polarity is reversed from input to output of a video-amplifier stage.

The sync signal can be injected into the sync section of a receiver in order to isolate a defective stage or component. Since the required sync polarity might be either positive or negative, depending on the point of injection into the receiver circuitry, a control is provided in the generator to reverse the sync-signal polarity.

Rainbow Signal

One type of color-TV analyzer provides a 3.56-mc rainbow signal. This rainbow signal is available directly for signal-injection tests of chroma circuits in color-TV receivers. An attenuator is provided to adjust the level of the color test signal. When RF input to the receiver is desired, the 3.56-mc oscillator can be switched into the RF modulator section. A simple (unkeyed) rainbow pattern is displayed on the screen of the color picture tube when there is no slide inserted in the generator. If a bar-pattern slide is inserted into the optical chamber, a keyed-rainbow pattern is displayed on the receiver color picture tube.

IF Injection Signal

Color-TV analyzers provide IF injection signals, in addition to RF output.

An attenuator is provided for control of the IF output signal level. This attenuator permits the test signal to be injected progressively at each IF stage in a receiver, to localize a faulty section or component. In summary, the operator can use the three types of signal outputs from a color-TV analyzer to check the operation of each stage from the antenna-input terminals to the picture tube. Note in passing that various other test signals are also provided by a color-TV analyzer; these comprise an AGC pulse output, modulated or unmodulated 4.5-mc sound signal, audio test signal, sawtooth drive voltages for the horizontal and vertical deflection circuits, yoke-test signal, leakage and continuity test functions, and a variable bias output.

Individual Color-Bar Signals

Another type of color-TV analyzer supplies individual 3.58-mc color-bar signals instead of a rainbow signal. Each color bar is a chroma signal which has the phase specified by NTSC standards for the particular hue. However, the generator circuitry is simplified to the extent that the brightness level is not provided in the color signal; hence, the operator adjusts the brightness control of the color receiver as required by the particular signal. Typical chroma signals supplied by this type are red, green, blue, yellow, cyan, magenta, R-Y, B-Y, I, Q, and burst.

Fig. 7. Color-bar and dot generator.

Scopes for Color TV

Scopes are used in both black-and-white and color servicing. Various types of scopes are available, and the wide-band scope is specially designed for color-TV requirements. Thus, the wide-band scope is classified as a color test instrument. Flat frequency response is provided through 3.58 mc and often up to 4.5 or 5 mc.

The necessity for wide-band response in color-TV scopes is due to the high video frequencies, which can be disregarded in most black-and-white TV test procedures, but assume fundamental importance in color-TV servicing. In addition, ample pattern brightness is necessary to display chroma waveforms satisfactorily. High sensitivity is very desirable, although highly sensitive wideband scopes are comparatively costly. Some technicians prefer to adopt various expedients, when necessary, instead of investing in a very costly wide-band scope. For example, a direct cable might be used in some tests to obtain useful vertical deflection, although an undistorted pattern would be provided by a low-capacitance probe (a low-C probe imposes a 10-to-1 signal attenuation).

Your B-W Instruments

Sweep-alignment equipment for black-and-white TV servicing is usually adequate for RF and IF alignment of color-TV receivers. However, it is quite desirable to have a sweep range that extends below the IF frequencies to check bandpass amplifiers in color receivers. This requires a video-sweep output. If your present generator can sweep a video amplifier, it is suitable for sweeping chroma circuits. In general, alignment is more critical in color work, and only good-quality sweep and marking equipment should be considered.

Building Your Own

Less elaborate color-TV test equipment that gives good performance is available in kit form (Fig. 7). Considerable cost can be saved if the time is available to spend in constructing kit-type instruments. It is the responsibility of the builder, of course, to adjust and calibrate the instrument properly after it is completed. Instructions are always given in this regard. If difficulties are encountered, the kit manufacturer will work over the complete instrument, make it operate as intended, and calibrate it accurately for a service fee. Fellow technicians in your area can also be called on for advice and assistance.

Sweep Generators

Good alignment is essential for satisfactory color-TV reception. RF and IF alignment procedures are basically the same for black-and-white as for color receivers; however, the adjustments are somewhat more critical for color reception. This implies that only good-quality sweep generators should be used. The chief requirement is a reasonably flat output from the sweep generator. To check the output from an RF sweep generator, it is good practice to connect a resistive 300-ohm matching pad to the output cable.

Video frequencies range from 60 cps to 4.5 mc. However, service-type sweep generators commonly provide a video-frequency sweep output from 50 kc to 4.5 mc. Older types of video-frequency sweep generators, which were designed for black-and-white service, often have a range from 150 kc to 4.5 mc. These latter models are satisfactory for color-TV tests, provided their output is reasonably flat.

Accessories

You are probably familiar with the method used to disable a gun in a color picture tube; a 100K resistor is connected between the control grid and ground. This bleeds off some of the positive DC voltage from the grid and, in effect, makes the grid negative with respect to the cathode. In turn, the grid does not permit electrons to flow through the gun to the viewing screen. When a color picture tube is set up, the guns must be disabled in turn. To facilitate disabling of the guns, some color-bar generators and analyzer instruments provide built-in gun-switch facilities.

A gun-killer plug-and-socket unit is connected to the switching circuits of the generator by a cable. In application, the socket is removed from the base of the color picture tube in the receiver, and the plug-and-socket unit from the generator is pushed on the base of the picture tube. Then the picture-tube socket is pushed on the base of the plug-and-socket unit. This makes the picture-tube electrodes available at the front panel of the color generator, and any one or two guns can be disabled by simply rotating the gun-killer switch.

Another accessory function is a deconvergence assembly. This is a DC electromagnet which is connected to the generator switching circuits by a pair of leads. The deconvergence assembly is clamped to the neck of the color picture tube during convergence procedures. When it is desired to split a white dot pattern into red, green, and blue dots, or to split a crosshatch pattern into red, green, and blue lines, a switch is thrown which passes current through the electromagnet. This feature eliminates the necessity of readjusting the static-convergence controls during dynamic-convergence procedures.

Degaussing Coil

Purity adjustments for a color picture tube require that no stray magnetic fields exist in the metal structures. Demagnetization procedures are often required before good color purity can be obtained. This entails the use of a degaussing coil, which is a large 60-cps electromagnet. You can construct your own coil by winding about 500 turns of No. 20 magnet wire in a "doughnut" about 15" in diameter. The coil terminals are connected to a cord with a plug for insertion into a wall socket. Note, a degaussing coil should not be left plugged into a 117-volt line when it is not in use; it will overheat.

Another precaution to be observed is not to place the degaussing coil over a meter or any device which contains permanent magnets—the AC field from the coil will weaken the permanent magnets. You will find a degaussing coil useful in the maintenance of any equipment which normally has a zero residual magnetic field. For example, a deconvergence assembly (part of a color-TV analyzer) can be troublesome if it develops a residual magnetic field. In such case, merely place the deconvergence assembly in the field of a degaussing coil, and then slowly remove the coil to a distance of several feet. Any residual magnetism in the deconvergence assembly will be eliminated by this procedure.

Color CRT Testers

Picture-tube testers are available both as individual instruments and as an auxiliary function of a receiving-tube tester. They are classified as either emission or beam-current types. Emission testers measure the total cathode emission, while beam-current testers measure the electron flow that passes through the aperture in the control grid to the screen. Since only the central area of the cathode contributes to beam current, a beam-current test gives more detailed data than an emission test.

High-Voltage Probes

When you are troubleshooting the high-voltage power supply in a color receiver, it is helpful to monitor the output as components are replaced or adjustments are made. Unless the high voltage can be measured, various obscure symptoms of defective color-picture reproduction might be falsely attributed to other sections, when the trouble is actually due to poorly regulated, deficient, or excessive output from the high-voltage power supply. Measurements can be made with either a VOM or VTVM when a suitable high-voltage probe is used. Note that the probe must have a suitable multiplier resistance with respect to the input resistance of the VOM or VTVM; therefore the meter scale will not be direct-reading but will require interpolation.

Heterodyne Frequency Meter

You will find a heterodyne frequency meter very useful in color-TV service procedures. This type of instrument is also called a television calibrator and will serve as an accurate marker generator in RF and IF alignment work. A heterodyne frequency meter will indicate whether the subcarrier oscillator in a receiver is operating at the correct frequency. It will also indicate whether a chroma oscillator or a sound-carrier oscillator in a generator is operating at the correct frequency. Various other facilities which cannot be discussed here are provided by a heterodyne frequency meter.

When designed for TV service, a heterodyne frequency meter may have a lower frequency limit of 18 or 20 mc. This might seem to prohibit tests of chroma, rainbow, and subcarrier oscillators; however, the technician merely checks a suitable harmonic in such case—color oscillators have strong harmonics. The sixth harmonic of a chroma oscillator should measure 21.48 mc; the seventh harmonic should measure 25.06 mc. When carefully used, a service-type calibrator has an accuracy of .01% ▲

before you buy any color generator . . . get all the facts

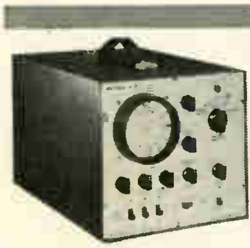
only one has all these features and it's only 99[50]*

LECTROTECH V6

Any comparison will prove that the Lectrotech V6 truly stands alone. Provides all of the time-tested standard features plus many Lectrotech exclusives for the fastest, most reliable color installation and servicing. The V6 gives you: Crystal-controlled keyed rainbow color display • All cross hatch, dots, vertical lines only, horizontal lines only • Red-blue-green gun killer (usually extra or not available on other color bar generators) • Exclusive Dial-A-Line feature (Horizontal adjustable 1 to 4 lines wide) • Exclusive solid state reliability • Exclusive voltage-regulated transistor and timer circuits • Exclusive simplifed rapid calibration • Off-On Standby Switch • Adjustable dot size • Color level control • Connects to antenna terminals (no connections needed inside of set) • Power transformer–line isolated, to prevent shock hazard • Lightweight and portable, only 4½" H. x 7⅝" W. x 10⅜" D. Weight, 7½ lbs.

*Except our own V7

One Year Warranty—Service and Parts



V7 Sensational new Lectrotech V7 — the only complete Color TV Test Instrument.

Has all the features and performance of the V6 PLUS Lectrotech's exclusive built-in Color Vectorscope for simplified visual color servicing.

Complete.................... only **189[50]**

See your distributor or write for details before you buy any color generator.

LECTROTECH, INC.
1737 Devon Avenue • Chicago, Illinois 60626

MADE IN U.S.A.

it's here! most advanced color TV test instrument ever developed

- **OBSOLETES ALL OTHERS**
- **ELIMINATES ALL GUESSWORK**

LECTROTECH V7*

A sensational new color generator with 4 major Lectrotech exclusives . . . plus all of the time-proven standard features . . . in one compact, portable unit. For the first time, you can install and service color TV completely, accurately and faster! Here are the facts:

EXCLUSIVE—COLOR VECTORSCOPE—Until now, available only in $1500 testers designed for broadcast. Accurately measures color demodulation to check R-Y and B-Y plus all 10 color bars for color phase angles and amplitude. A must for total color and those hard to get skin tones.

EXCLUSIVE—SELF-CALIBRATING — Adjust timing circuit without the use of external test equipment. No need to return unit to a factory for adjustment.

EXCLUSIVE—DIAL-A-LINE — Now, you can adjust horizontal line to any width desired from 1 to 4 lines wide.

EXCLUSIVE—SOLID STATE RELIABILITY — Only two tubes are used in combination with fully transistorized diode-rectifier circuit.

PLUS— the V7 produces all Crosshatch, Dots, Vertical only, Horizontal only and Keyed Rainbow Patterns. RF at channels 3, 4 or 5. Video Output (Pos. and Neg. adjustable) for signal injection trouble-shooting. Red-Blue-Green Gun Killer. All transistor and timer circuits are voltage regulated to operate under wide voltage ranges. Lightweight, compact — only 8¾" x 7½" x 12½". Net.................. **189.50**

**Designed and produced by the men who introduced and developed the modern approach to TV testing — Bill Grossman and Bob Koret.*

For the full story on the V7, write for complete catalog or see your distributor.

V6 Complete color bar generator with all the features of the Lectrotech V7 except the Vectorscope. Only **99.50**

Distributors: Phone or Wire Collect.

LECTROTECH, INC.
1737 Devon Ave. ■ Chicago, Ill. 60626 ■ Area 312 465-2622

using your head... in color Servicing

Analytic techniques save time and tears.

by Wayne Lemons

The brainwork in color TV servicing, can't always be neatly boxed up and tied with a red ribbon, and never will be as long as we have continuous model changes and refinements to interacting circuitry. Our thinking processes must be flexible or our service methods may get as obsolete as ion traps.

Too often in troubleshooting we move from the general to the particular in a devious, unexplainable, and frequently indefensible fashion. We amputate here, temporarily insert there, use abstraction, subtraction, and considerable retroaction, and finally stumble, or perhaps ricochet, onto the trouble that was staring us in the face all the time.

A lot of mental exertion has gone into attempts to systemize and organize the thinking processes of servicing so that we always arrive at the solution with the mechanical cunning and precision of a Univac playing tic-tac-toe. But, unlike the computer, most of us are not so routinely humdrum. We skillfully leap to false conclusions, right ourselves, and leap to other conclusions which are apt to be false also. I wouldn't want to stamp out this wonderously human trait but perhaps it could be carried to less ridiculous extremes.

We would be the last to say that experience doesn't sharpen a technician's thinking and trim away the fat (headedness) that often plagues the beginner and old-timer alike. On the other hand, experience can be a wearisome teacher that leads the old-timer into producing blunders that the neophyte wouldn't have "experience" enough to make. Here's what I mean.

Troubles Experienced

A comparatively new RCA color set came into the shop with no raster and no high voltage. A 3A3 cured the trouble for a few minutes; then, as if in warning of bad times ahead, the raster faded away right before my eyes. Substituting another 3A3 didn't help. I measured the high voltage—21KV. Here experience came to my rescue. Since I had once spent two hours in the wrong circuit looking for a trouble, I knew that a loss of focus voltage would cause a loss of raster. The focus circuit seemed like a good place to point my probes, and it was; a new 1V2 focus rectifier returned the raster from its short vacation.

I wasn't through with this set yet, or to put it better perhaps, it wasn't through with me! The raster was secure on the screen and the black and white picture was beautifully in focus, but there was a new fly in the ointment—the last inch or so at the right edge of the screen had no raster. At first it looked like a matter of centering, but centering just moved the raster loss to the left side. I concluded from "experience" that there wasn't enough width, so I went to work on the horizontal circuit. Somewhat later, after thoroughly checking most of the horizontal circuit, I reached the conclusion (perhaps the first time I had used my head) that I really had no conclusions.

Now comes the minor miracle that sometimes comes to technicians if they fiddle with a set long enough, a sign that leads him to look for the trouble in some other circuit. Idly turning the brightness control revealed a new clue—there *was* a full raster if the brightness control was advanced enough, but the outer inch or so of the raster was still considerably darker than the rest. "Blanking troubles" popped into my thinker and I was off on the trail like a bird dog after a rabbit. Removing the blanker tube, which shared the same envelope with the G-Y amplifier, filled out the raster like a certain Miss Taylor. Unfortunately, inserting a new blanker tube just made the raster inhale again.

"Circuit troubles, you'll have to pull the chassis," whispered the thinker. By the time the chassis was pulled, the cable connections made, and all the resistors and capacitors in the blanking circuit checked, it was time for the afternoon color show. Since I seemed to be getting nowhere fast with the blanking trouble, even after some half-hearted signal tracing with the scope, I decided to see what the color looked like on the errant set. No color! Oh no, not that too! I decided I might as well start on the no-color symptom since I was getting no place with the blanking problem. I checked the tubes in the color circuit. The 6EW6 burst amplifier was shorted. Replacing it brought in good color and as anyone would have known who had been smart enough to check the tubes in the color section in the first place, the raster was, well . . . Elizabeth again.

Rule one for human computers: If you don't know the circuit, check all the tubes. No telling what some miserable engineer may have dreamed up. In this case I discovered a very sneaky connection from the cathode of the 6EW6, through the color killer control and through a resistor, right to the grid of the blanker tube (see Fig. 1). Even if I had spotted it I probably wouldn't have supposed it to be the source of my trouble.

Color Experience Needed

Not long ago an RCA color set came in with sound but no picture. I was too long in discovering that the low B+ was caused by an *open* silicon rectifier in the bridge circuit. The first open one I had ever come across—shorted, yes, but not open.

Two Zeniths

At another time in a Zenith set a problem cropped up that looked exactly like a defective fine-tuning circuit, but it turned out to be an open delay line.

An intermittent vertical roll in another Zenith set was caused by a defective high-voltage regulator tube; but later, in the same chassis, the same fault was caused by an open AGC bypass in the tuner circuit.

Another RCA

In an RCA set intermittent oscillation in the picture resulted from a couple of loose screws that hold down the printed-circuit IF and also provide a low-impedance ground. Another time the oscillation was due to a bad connection between the shield of the IF cable and the tuner; still another time an oscillation was caused by an intermittently open capacitor across the 920-kc trap.

An Admiral

An intermittent loss of color in an Admiral proved eventually to be caused by a misadjusted horizontal circuit, although the black and white picture was not affected. Recentering the horizontal ringing coil was all that was needed to get us back in business . . . not too often that you can repair an intermittent with an adjustment, but it happened here. The killer was one of those "noise immune" jobs that, killer like, was not only slaying noise but color signals as well when the horizontal phase was not exact.

A Magnavox

In a Magnavox an intermittent separate hula weave in each of the colors that did not affect the black and white picture was cured with a new horizontal-output tube, but I still don't know if I could explain it.

Another Zenith

We mentioned focus troubles earlier. Focus-voltage loss in a color receiver always dims the raster, but twice in a Zenith set I've had a defective focus tube cause a bright horizontal band across the picture along with the dim raster. (When I decide just how that happens I'll let you know.)

Conclusion

Certainly this must be pointed out. There are many troubles that can be localized by deciding whether the problem is in the black and white or color section of the receiver, then isolating the trouble by simply checking out that section. However, as most of the troubles above show, you can't *always* consider the circuits separately. If you do, your thinking can get rigor mortis . . . and that's deadly. ▲

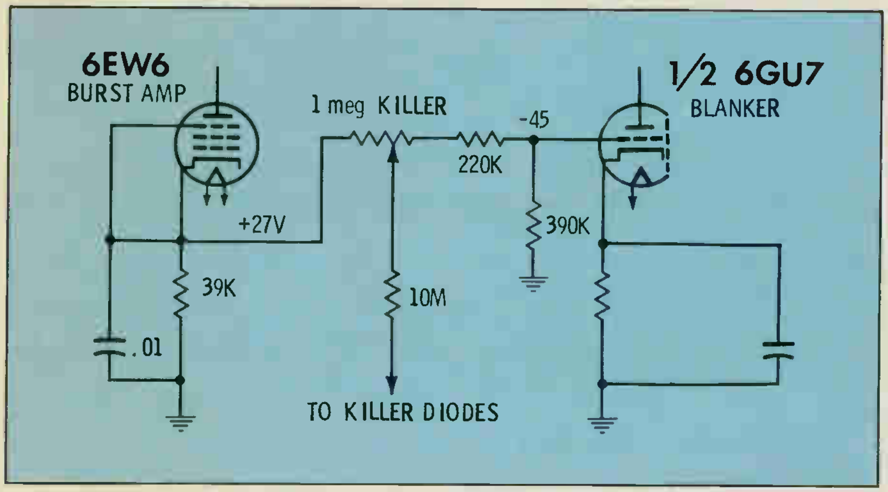


Fig. 1. A biasing circuit provided a path for a stray blanking voltage.

New RCA WR-64B Color Bar / Dot / Crosshatch Generator

THE ESSENTIAL COLOR-TV TEST INSTRUMENT

Now in a new model with more features for greater stability and versatility

- Crystal-controlled RF oscillator for stable picture carrier.
- Three additional crystal oscillators are used to produce the sound carrier, color sub-carrier signal and the three patterns.
- Convenient front-panel gun killing switches to aid individual gun testing as well as convergence and purity adjustments.
- Sound-carrier signal unmodulated for accurate adjustment of fine tuning control of TV receiver... accurate setting of the fine-tuning control is essential for checking the performance of the receiver.
- Generates all necessary test patterns: COLOR BARS for checking and aligning color circuits; CROSSHATCH for adjusting vertical and horizontal linearity and raster size; and DOTS for accurate convergence.
- Color-phasing adjustments may be made with this instrument in the home without a scope.
- The standard of the Color-TV servicing industry: much of the practical information available for trouble-shooting color circuits is based on the RCA Color Bar Generator.

Only $189.50*

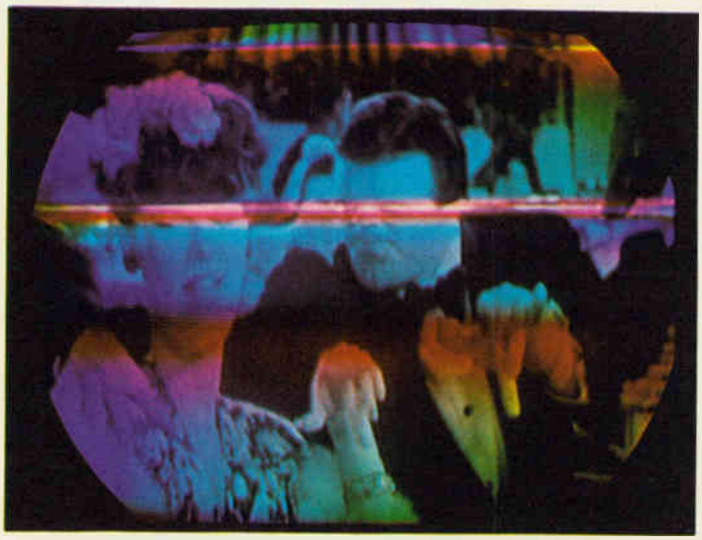
ASK TO SEE IT AT YOUR AUTHORIZED RCA TEST EQUIPMENT DISTRIBUTOR

*Optional distributor resale price. All prices subject to change without notice. Prices may be slightly higher in Alaska, Hawaii and the West.

RCA Electronic Components and Devices, Harrison, N. J.

RCA The Most Trusted Name in Electronics

Color - Picture Symptoms



...Troubleshooting clues

by Carl Babcoke

A handy method of troubleshooting is to use CRT picture symptoms. However, this required the troubleshooter to know what each symptom is telling him. The following article will help in at least two ways: the symptoms and tips will benefit the inexperienced serviceman, and they will aid the experienced serviceman who needs a review or a handy record of these symptoms and tips.

Normal Color Bars

Normal color bars for comparison purposes. There is always a certain amount of overshoot, green edge to right side of red bars, etc., and part of this is in the generator. Checking a new, normal set with your generator, note the sharpness and color fringing carefully and use that as your standard. Remove the antenna and disconnect the grid switch boxes (do not use extension cables on the picture tube, either). Also, the sound carrier should be used at the generator to provide a definite tuning indication. Tune until the beat (herringbone pattern) is seen in the color, then back off the fine tuning until the beat is gone. The same conditions should be observed each time a set is checked. If so, the color bars provide a nearly infallible test of the alignment and general color sharpness of the receiver.

Horizontal Streaks

The lines in the picture are caused by the video tape recording. Note that orange and yellow colors are particularly affected. This symptom is common to any make or model of color receiver.

Herringbone

This condition is caused by a 920-kc beat in the color broadcast. The beat is between the 3.58 mc color sidebands and the 4.5 mc sound carrier. This usually is a general symptom of misalignment.

Color Stripes on B-W

RF interference on a b-w program. Interference must be near 42.16 mc if it enters the IF directly, or near a point 3.58 mc above the carrier frequency of the channel tuned in.

Good Color

Cartoon photographed off the air. A slight ghost is present, but the color is good. A cartoon program is a very good test for set quality. Since the picture is made up of large color blocks, poor purity would easily show. Because the luminance detail is heavy black lines, any ringing or ghosts will be obvious.

Displaced Color

This is caused by the misconvergence of one color—in this case, green. In all cases of misconvergence, be sure to check the static convergence settings. Without this check, you may be working for nothing and have to readjust dynamic convergence.

Multiple Ghosts

Trouble caused by an open ground on the delay line seen as it affects a b-w cartoon. The same multiple ghost can also be caused by leaving the antenna on the receiver while the generator is attached.

Diagonal Color Stripes

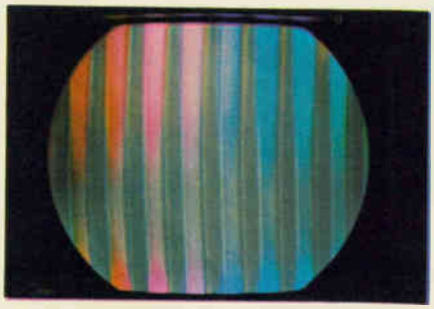
The color is out-of-lock on the color bar generator. Note that there is color only where the color bars should be.

Running Colors

Color is out-of-lock on the network color broadcast. Use a generator to check whether the trouble is in the receiver or at the station. Remember not to use a very strong signal from the color-bar generator. Some faulty sets which exhibit "out-of-lock" symptoms will lock on a strong signal from a color-bar generator.

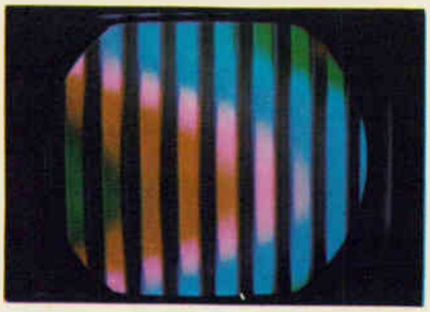
Impure Red

Poor purity on red screen color. Adjust position of purity rings and the yoke. Remember that a thorough degaussing of the CRT is necessary for good purity. Also check purity of blue and green screen.



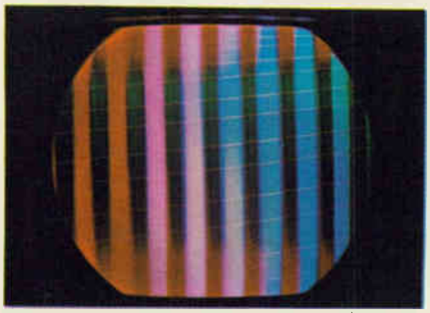
Color Hum

Distortion due to hum at the cathode of the bandpass amplifier on an RCA CTC16 chassis. No distortion was visible on b-w.



Distorted Color Bars

This symptom is due to hum being introduced at the cathode of the reactance tube in an RCA CTC16 chassis. No hum was present on b-w. Note that the bars are bent in the shape of a sine wave.



"X" Demodulator Hum

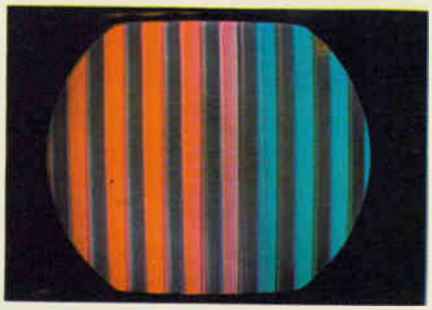
These lines are caused by hum at the cathode of the "X" demodulator on an RCA CTC12, CTC15, CTC-16, or CTC17 chassis. No hum visible on b-w with color control turned down.

"Z" Demodulator Hum

Hum at the cathode of the "Z" demodulator on an RCA CTC12, CTC15, CTC16, or CTC17 chassis. no hum on b-w. In just about all cases of hum indications in the video (b-w and color), the trouble is filament-to-cathode leakage in some tube that handles the video.

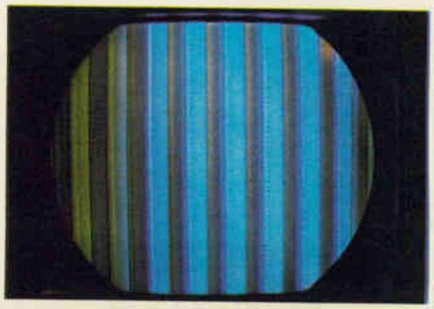
Video Hum

Hum at the common-cathode circuit of R-Y, B-Y, or G-Y amplifiers. Hum is also present on b-w. Video hum appears on any RCA chassis from CTC7 up.



No Blue

No "Z" demodulation. Since "Z" is closest to B-Y, the blue bars are missing and the green bars are reversed in brightness from that of the red bars. Any RCA chassis from CTC7 until current models will display this symptom. There is no change in b-w.



No Red

No "X" demodulation. Since "X" is closest to R-Y, red bars are missing and green bars are reversed in brightness from that of the blue bars. There is no change in b-w. In some cases, an advance warning of real hum trouble can be obtained by advancing the color level control to near maximum. This will show even slight leakage.

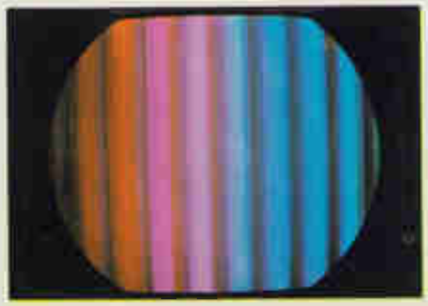
Rolling Color Bars

The color bars are actually rolling because of lack of color sync.

No Tint Control

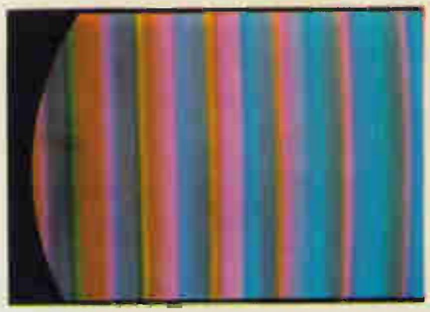
No 3.58-mc oscillator carrier. No change in b-w picture. This action occurs in RCA chassis CTC-12, CTC15, CTC16, and CTC17. RCA CTC7 to CTC11 bars will be purple. Tint control has no effect on bars; color control will turn them down. These bars are caused by demodulator overload on color sidebands only, so the color depends on the polarity of the demodulator.

Zenith sets show no color bars at all, but screen color goes bluish green.



Improper Colors

The R-Y amplifier has poor high-frequency response. The .01-mf capacitor across the 100K resistor in series with the red grid of the picture tube was open. This occurred on an RCA CTC16 chassis.

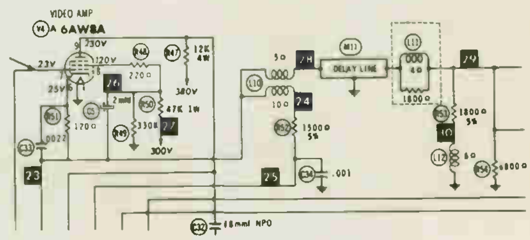


Color Bars Blurred

Bars blurred by misalignment. The fine tuning was turned far away from the sound bars, and the generator and color control were advanced to give full color. Note displacement of bars and general smeariness. Similar bars can be caused by poor IF alignment, and almost as bad a symptom can occur because of poor chroma alignment or multiple sets on the same antenna, poor distribution system, etc. A bar generator provides the best proof, but be sure to disconnect antenna before connecting bar generator. Some bar generators have RF adjustments which will effect the appearance of the color and blanking bars. ▲

COLOR COUNTERMEASURES

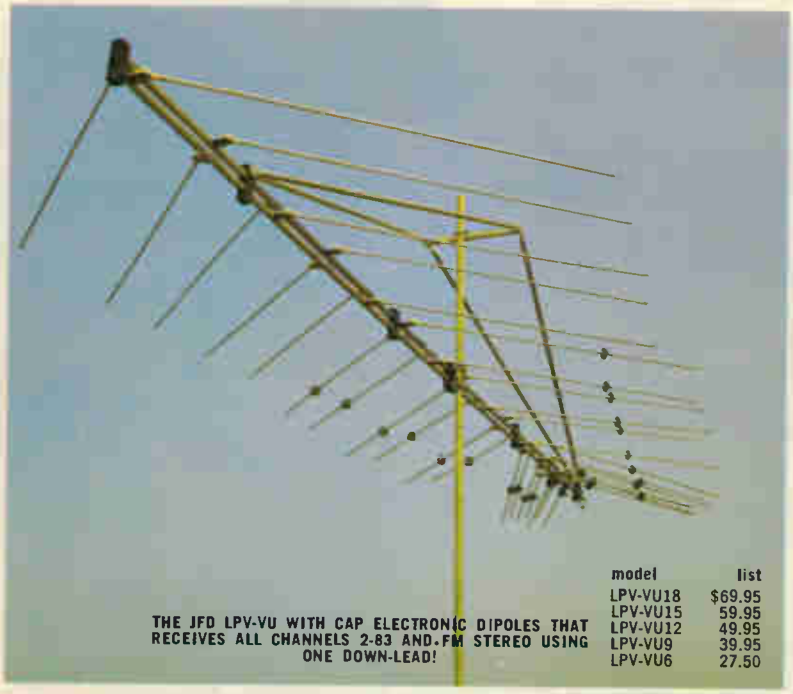
Symptoms and service tips from actual shop experience



Chassis: Admiral 25E6
Symptoms: Multiple ghosts.
Tip: The picture on the CRT screen will display multiple ghosts on both the left and right sides of the images, giving the appearance of excessive video ringing. This trouble is usually due to a defective delay line (M11) in the luminance channel. A change in its impedance causes video signals to bounce back and forth between the input and output. A quick test is to short the delay line with a clip lead. If the "ghosts" disappear—especially those on the right side of the images—replace M11. When procuring a replacement, make sure you get one that matches the particular receiver you're servicing.

Chassis: Zenith 29JC, 27KC, 26KC, 25LC
Symptoms: Unable to center raster.
Tip: The centering of the raster on Zenith's color receivers is accomplished by pulling two sets of gut strings extending from the rear of the deflection yoke. If they have no effect on the raster, the centering mechanism is probably defective. The only cure is to replace the entire centering device. This unit, shown in the photo, is not an integral part of the yoke; it's a separate unit, containing circular magnets, that fits inside the hole in the yoke. The magnets sometimes become unglued from their mountings, making the unit inoperative. As shown, the unit is fairly simple to replace—just snap out the old, and snap in the new.

Don't Be 1/2 Set... With JFD LPV Log

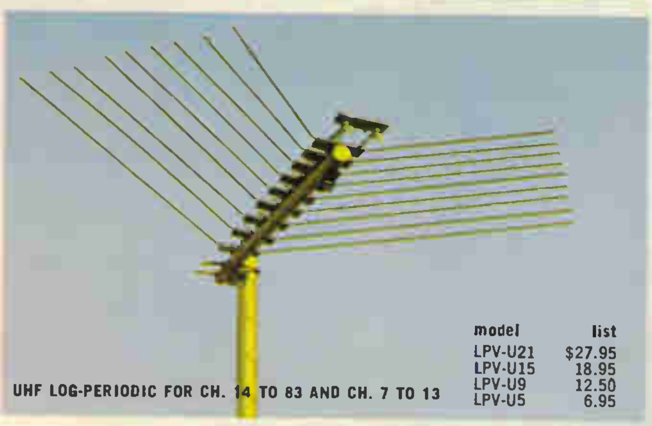


THE JFD LPV-VU WITH CAP ELECTRONIC DIPOLES THAT RECEIVES ALL CHANNELS 2-83 AND FM STEREO USING ONE DOWN-LEAD!

model	list
LPV-VU18	$69.95
LPV-VU15	59.95
LPV-VU12	49.95
LPV-VU9	39.95
LPV-VU6	27.50

NEW! LPV LOG PERIODIC WITH CAP-ELECTRONIC DIPOLE FOR VHF CHANNELS 2 TO 13

model	list
LPV-TV19	$69.95
LPV-TV16	59.95
LPV-TV13	49.95
LPV-TV10	39.95
LPV-TV7	29.95
LPV-TV5	21.95
LPV-TV3	14.95



UHF LOG-PERIODIC FOR CH. 14 TO 83 AND CH. 7 TO 13

model	list
LPV-U21	$27.95
LPV-U15	18.95
LPV-U9	12.50
LPV-U5	6.95

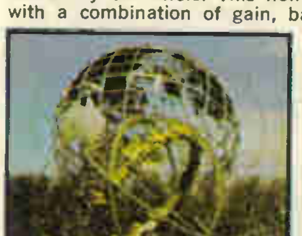
UHF ZIG-A-LOG ANTENNA FOR CHANNELS 14 TO 83

model	list
LPV-ZU20	$34.95
LPV-ZU10	15.95

Only JFD offers You LPV Log Periodics for VHF (Ch.2-13)...UHF

GET THE LION'S SHARE OF ANTENNA BUSINESS (FLATTEN CATV COMPETITION TOO) BY FEATURING THE JFD LPV-VU LOG PERIODIC! THIS NEW GENERATION OF LOG PERIODIC ANTENNAS DELIVERS WHAT VIEWERS WANT—MANY MORE STATIONS...VHF CHANNELS 2 TO 13...UHF CHANNELS 14 TO 83...FM/STEREO. GIVES THE CLEAN, UNIFORM SIGNAL SETS NEED ESPECIALLY FOR VIVID COLOR RECEPTION.

Only the LPV follows the patented frequency independent Log Periodic antenna formula developed by the Antenna Research Laboratories of the University of Illinois. This new log periodic cellular concept provides you with a combination of gain, bandwidth, directivity and impedance match never before possible with conventional antenna designs.



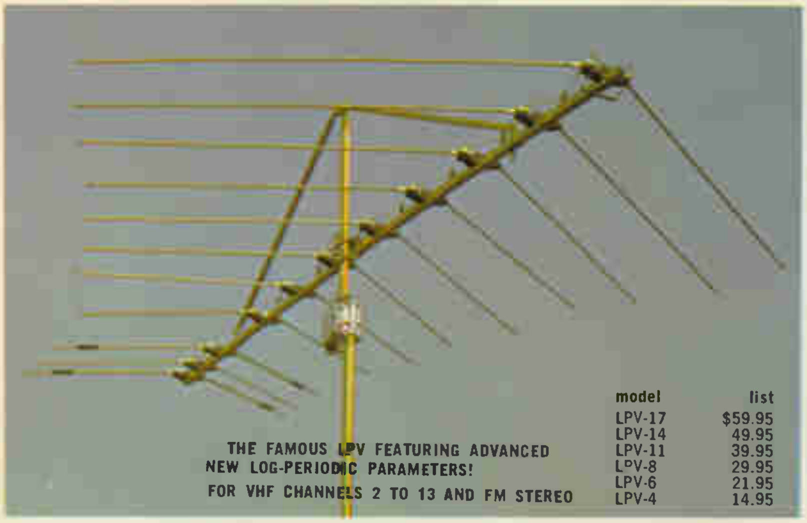
You can actually see the difference in truer color purity, in greater contrast, in finer detail—not on just some of the channels but all of the channels! Small wonder more JFD Log Periodics were installed in the last 12 months than any other brand.

PREFERRED BY MORE N. Y. WORLD'S FAIR PAVILIONS . . . New York World's Fair exhibitors demand flawless color reception. That's why the House of Good Taste, Masonic Pavilion, Formica House, Eastman Kodak Exhibit, New York City Exhibit, House of Japan and other Fair showplaces chose the JFD LPV. This exclusive preference is pre-selling millions of Fairgoers—opening the door for more LPV sales by you.

WHY THE LOG PERIODIC IS THE MOST DRAMATIC BREAK WITH ANTENNA TRADITION SINCE DR. YAGI INVENTED THE YAGI . . . Up until the JFD Log Periodic, it was not possible to devise a truly broadband antenna except by "compromise" design that had to give up vital gain to get wider bandwidth . . . or had to degrade directivity for better impedance. Burdensome parasitics were piled on to try to compensate for gain "suck-outs", ghost-prone polar patterns, and inadequate bandwidth. This pyramided performance complications resulting in signal-sapping standing waves and impedance matches—and yet were only effective at the band edges.

Through the use of the revolutionary new logarithmic periodic formula, the entire frequency range is covered with dipole

Be *All* Set—
Periodic TV & FM Antennas



(Ch. 14-83)...FM/Stereo...VHF/UHF/FM-COLOR & Black/White

groups (cells) of overlapping resonances. These harmonically resonant V-dipoles result in a frequency-independent performance. The LPV's inherently high gain, sharp directivity, 300 ohm impedance match and flat response are virtually constant across the entire band.

AND ONLY THE JFD LPV HAS IT! . . . The JFD LPV is the product of the world's largest and newest antenna laboratories. Here, in the JFD Champaign, Illinois R & D Research Center, a team of scientists and engineers, under the direction of Dr. Paul E. Mayes, are revolutionizing the state of the antenna art.

MECHANICALLY SUPERIOR! . . . COMPARE CONSTRUCTION! . . . Life-time stainless-steel take-off terminals that can never corrode, "tank-turret" element brackets, tough heavy-wall Implex A acrylic insulators, twin U-bolts with 6 inch mast grip span; supple, permanently riveted aluminum drive line rod; electrically conductive gold alodizing; plus a host of other exclusive mechanical improvements.

FIGHT CATV WITH THE JFD LPV! Keep CATV out of your area with JFD Log Periodics (such as the 82-channel LPV-VU) which provide viewers with more channels—sharper reception—richer color—plus FM stereo. Don't install inferior antennas that open the door to CATV. Install the best to get the best performance—the LPV!

ADVERTISED IN LOOK, SUNSET . . . COMPARE ADVERTISING AND PROMOTION! . . . A versatile selection of indoor and outdoor sales helps . . . advertisements in LOOK, SUNSET and other national and local consumer publications . . . in newspapers . . . on television . . . sell your best prospects.

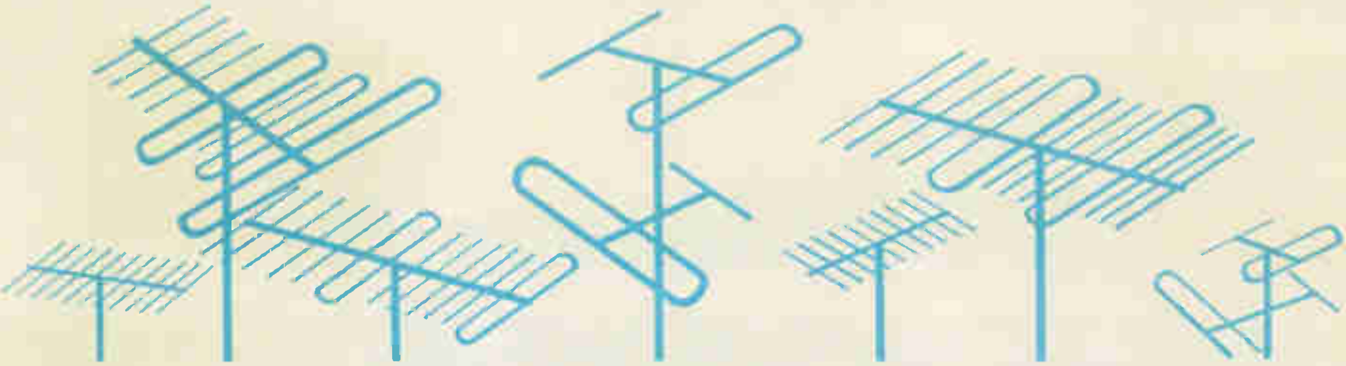
Now is the time and your JFD distributor is the place to stock up and step up into big-league LPV Log Periodic profits.

SEE WHY AT THE MOMENT OF TRUTH THE PICTURE IS THE PROOF THE JFD LPV LOG PERIODIC WORKS BEST!

Licensed under one or more of U.S. Patents 2,958,081, 2,985,879, 3,011,168, 3,108,280, 3,150,376 and additional patents pending in U.S.A. and Canada. Produced by JFD Electronics Corporation under exclusive license from the University of Illinois Foundation.

JFD

JFD ELECTRONICS CORPORATION
15th Avenue at 62nd Street, Brooklyn, N. Y. 11219
JFD Electronics-Southern Inc., Oxford, North Carolina
JFD International, 64-14 Woodside Ave., Woodside 77, N. Y.
JFD Canada, Ltd., 51 McCormack Street, Toronto, Ontario, Canada



The story of color TV antennas

How and from what you can choose.

by Cy Moody

Are you getting your share of business installing antennas specifically designed for color reception? If not, you should be. The steadily increasing number of color receivers being purchased today is creating a larger and larger market for antennas of this type.

As we all know, the average lay customer does not fully understand the true importance of the antenna to good signal reception in any kind of broadcasting. In b-w TV, for example, he soon discovered he could get by with somewhat less than the best insofar as antenna requirements were concerned, expecially in metropolitan and suburban areas. Customers quickly learned to tolerate slight ghosts and some snow in their pictures once they became absorbed in the story or event they were watching.

Add color to the picture however, and the situation changes. The customer expects (and rightly so) the colors in his picture to be true and lifelike, and any distortion in the picture, however slight, is easily spotted by even the most untrained eye. Snow and ghosts both appear in a variety of unnatural colors and quickly divert the viewer's attention. Naturally, therefore, complaints come sooner and more often.

Many of these complaints, perhaps even a majority of them, could be prevented easily with the installation of a suitable antenna. A good antenna is an absolute necessity for satisfactory color reception. Obviously, many other factors also affect the quality of the color picture, but without a good beginning at the antenna terminals, we cannot possibly have a good ending at the picture tube. Thus, proper signal input to the color receiver is vital, even in metropolitan or strong-signal areas.

Fully aware of this situation, antenna manufacturers have spent considerable time and money over the past several years in research and development of color-TV antennas that will provide sufficient gain, bandwidth, and selectivity for customers in all areas. This article is intended as a guide to technicians on the recent developments in color antennas and as an aid to making the proper selection of antennas for customers in your particular area.

Color Antenna Requirements

In a strict technical sense, the requirements for color antennas are little different than for black and white. The big demand today is for broadband or all-channel antenna types; and, with the new Federal law requiring all commercially manufactured TV receivers to contain both VHF and UHF tuners, the problem is further complicated by a rising demand for all-channel antennas that will cover the complete range of television frequencies from channel 2 to channel 83.

Let us now examine the three basic requirements and see just what is necessary in making the proper selection of antennas for your customers.

Gain

The gain required is dependent on the amount of signal present at the antenna site, together with whatever losses can be expected from lead-in requirements. (For every 100′ of 300-ohm lead-in, approximately half the signal will be lost.) For color receivers, signal strength should be at least 150 to 200 uv at the receiver antenna terminals to obtain consistently good pictures. (This compares to approximately 100 uv for black-and-white). In most areas, this amount of signal can be expected at the height of a two-story building up to 80 or 100 miles from the transmitter.

To select the proper antenna for gain requirements, first determine how much signal is available and then calculate approximately what lead-in losses are to be expected. (As stated, roughly half the signal will be lost for every 100′ of lead-in. To make allowance for any additional losses—weather, etc.—this figure should be increased to three-fourths when making calculations.) Signal availability can be easily determined with a field strength meter, or by making a temporary installation trying different antennas and making a visual check of the reception.

Bandwith

Bandwidth requirements for color TV are somewhat more critical than for black-and-white. Whether the antenna is for single-channel reception, low VHF band, high VHF band, or both, or if it is one of the newer models covering all VHF and UHF channels it *must* have relatively flat gain characteristics across the band of frequencies it was designed to receive. There can be no sharp dips in the response curve of the antenna; otherwise, the 3.58-mc chrominance signal may be reduced excessively or lost completely on certain channels.

Considerations for bandwidth

primarily involve how many channels are receivable in a particular area and how far apart they are spaced across the TV bands. The customer's wishes must also be taken into account. If he is a "channel-searcher" and wishes to receive as many fringe stations as he can, then a long-distance, high-gain, all-channel type of antenna is called for. However, if he is satisfied just to have good reception on two or three local stations, then perhaps individual cut-to-channel yagis, or a lower-gain multipurpose type which will cover the stations involved, would do the job better.

Selectivity

The importance of this factor in color TV cannot be stressed too heavily as it affects the clarity of the signal received. That is, the freedom of the received signal from side reflections, ghosts, or noise. Antennas for color reception must be highly directive in their forward lobe patterns especially in large metropolitan areas where a considerable amount of signal reflection from large buildings, etc., can be expected.

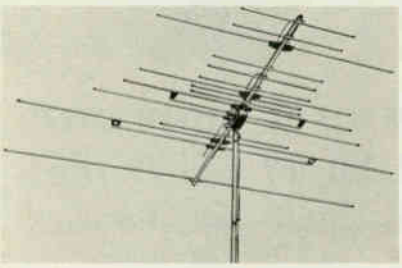


Fig. 1. Broadband yagi for medium-fringe reception on all VHF channels.

The factor of selectivity or directivity is virtually a must. Any antenna that is to be installed primarily for color reception must have good directional characteristics with a good front-to-back ratio.

What Type?

The foregoing considerations would appear to point directly toward the single-channel or multi-channel yagi as the best answer for consistent color reception. In a sense, this is true since many of today's antennas are simply modifications of the basic yagi design. This design, which is one or two driven dipole elements with up to 14 directors and one or two reflectors, offers high gain and high directivity, but with a rather narrow bandwidth, suitable only for single-channel reception. These cut-to-channel yagis were very popular in the early days of b-w TV, when most areas having TV had but one station with which to contend. In some areas today, this situation still exists; where it does, a single-channel yagi will prove very satisfactory for color reception as well as b-w.

Modern variations of the basic yagi have increased the bandwidth of the antenna while retaining the high-gain and high directivity characteristics. These broad-band yagis are available to cover either the low or high VHF bands, or both. This type of antenna is entirely satisfactory for color reception in ordinary weak-signal areas where only a few (2 or 3) VHF stations can be received. Fig. 1 shows one example of the broad-band yagi type. While the model shown is for medium fringe reception (up to 50 or 60 miles), other versions of this type are available for extreme fringe areas and also for metropolitan and near-fringe areas.

Further antenna research in recent years has brought about the development of another concept in broadband high-gain antenna design. Known as log-periodic spacing, this design, is based first of all on the transposed-harness type of antenna which incorporates a large number of active dipoles connected together in a special phasing arrangement. This results in reinforcement of signals arriving from the front of the array and cancellation of pickup from the rear.

The log-periodic concept spaces the active dipoles in accordance with a logarithmic formula based on the theory of an infinite spiral. Such spacing broadens the bandwidth of the array by blending the resonant characteristics of each dipole into a uniform frequency response that covers a wide range of television frequencies. Early log-periodic antennas were designed to cover just the two VHF bands, while more recent versions have incorporated parallel-plate capacitors into the dipoles precisely adjusted for capacitance and location. This has the effect of increasing the number of active elements and, according to the manufacturer, creates a bandwidth capable of covering the entire range of TV frequencies from channel 2 to channel 83. This antenna is illustrated in Fig. 2.

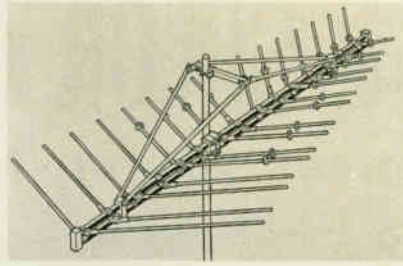


Fig. 2. Log-periodic type which claims entire frequency coverage of TV bands.

Another recent development in log-periodic antennas incorporates wheel-like insulating mounts for the active dipoles. Inside these plastic insulators are two-conductor strips which permit strapping of the dipoles together according to the transposed harness concept without any crossing of transmission lines.

Because of the more critical requirements of color TV, even in metropolitan areas many manufacturers are now introducing special outdoor types designed to meet the rising demand of the large city and suburban markets for a good but inexpensive color antenna. These units, in general, will provide the necessary broad bandwidth with flat response characteristics required for color reception but with somewhat less gain than more expensive long-distance arrays. They are, however, satisfactory for color reception in metropolitan and suburban areas.

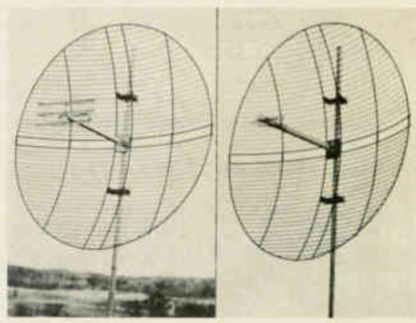
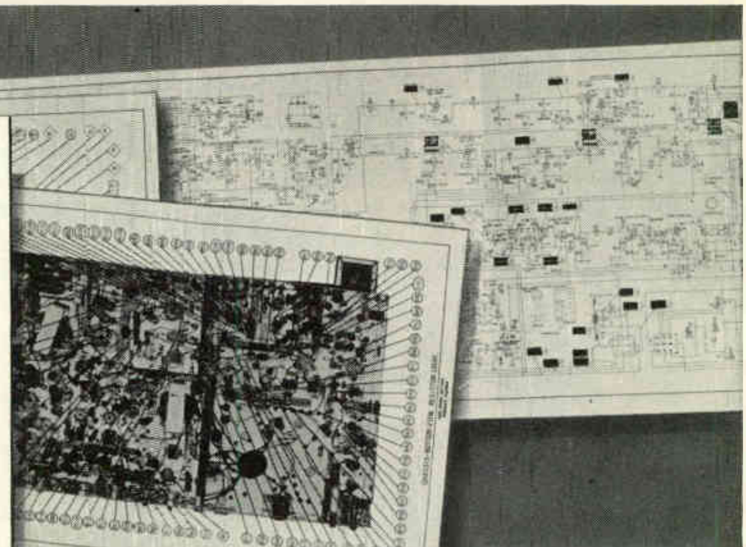


Fig. 3. Two parabolic-dish antennas suitable for UHF channels 14 to 83.

Antennas suitable for color reception on UHF must be mentioned also now that the boom is on in these frequencies. Most manufacturers provide a variety of these types for either single-channel or broadband reception. Just as with VHF reception, the type selected will depend on the number and location of such channels in a particular area. Two types of UHF antennas satisfactory for color reception are shown in Fig. 3. ▲

FULL COLOR TV COVERAGE IN PHOTOFACT®

gives you up-to-the-minute servicing know-how!



COLOR TV COVERAGE AVAILABLE IN PHOTOFACT THROUGH FEBRUARY 1965:*

Photofact Set	Brand
252	RCA Victor
259	Westinghouse
262	Arvin
265	Stromberg-Carlson
283	Motorola
293	CBS-Columbia
299	Sparton
300	RCA Victor
305	Hoffman
314	RCA Victor
320	Sentinel
323	Magnavox
324	Airline
327	Capehart
344	Sentinel
346	Philco
353	RCA Victor
357	Westinghouse
358	RCA Victor
371	Motorola
378	Raytheon
382	Truetone
383	Admiral
385	Hoffman
386	Packard-Bell
388	Silvertone
399	RCA Victor
412	Emerson
433	RCA Victor
437	Westinghouse
459	RCA Victor
495	Admiral
517	RCA Victor
540	Admiral
546	Packard-Bell
565	General Electric
576	DuMont
584	Silvertone
588	Magnavox
592	Emerson
596	Olympic
599	Zenith
614	Packard-Bell
626	Sylvania
627	Delmonico

Photofact Set	Brand
640	RCA Victor
643	Andrea
644	Westinghouse
650	DuMont
653	Magnavox
655	Silvertone
658	Sylvania
660	Bradford
663	Zenith
665	Curtis Mathes
670	Coronado
673	RCA Victor
678	General Electric
680	Airline
683	Philco
685	Packard-Bell
688	Zenith
690	Westinghouse
693	Sylvania
695	Motorola
698	Philco
700	Airline
703	Admiral
705	Zenith
708	Magnavox
710	Magnavox
713	Silvertone
715	Setchell-Carlson
716	Truetone
717	Penncrest
719	Emerson
721	Motorola
722	Zenith
724	DuMont
726	Coronado
727	Muntz
729	General Electric
731	Olympic
732	Electrohome
734	Andrea
736	RCA Victor
737	Catalina
739	Motorola
741	AMC

* An average of 3 Color TV chassis now covered monthly in current PHOTOFACT

HAVE EVERYTHING YOU NEED TO PERFORM EXPERT

PROFITABLE COLOR TV SERVICING!

- Famous SAMS "Standard Notation" Detailed Schematics
- Chassis View Photos
- Disassembly Instructions
- Set-up Adjustments
- Full Alignment Data
- Resistance Charts
- Tuner Schematics
- Block Diagrams
- Waveform Diagrams
- Tube Placement Charts
- Complete Parts Lists

Plus dozens of other invaluable PHOTOFACT features

FOR THE COLOR TV COVERAGE YOU NEED, check your latest PHOTOFACT Master Index—the issue dated February, 1965 includes a special section listing all Color TV makes and models now covered in PHOTOFACT—so you can instantly locate the Color TV PHOTOFACT Folder you want. See your Sams Distributor—he stocks all PHOTOFACT Sets to fill your requirements immediately.

STAY AHEAD IN COLOR TV WITH THESE PRACTICAL SAMS BOOKS

Color TV Training Manual, New Second Edition

by C. P. Oliphant & Verne M. Ray. This newly revised comprehensive manual is the most up-to-date guide available for technicians preparing to service color-TV receivers. Chapters: Colorimetry; Requirements of the Composite Color Signal; Make-up of the Color Picture Signal; R-F and I-F Circuits; Video, Sync & Voltage-Supply Circuits; Band pass-Amplifier, Color-Sync and Color-Killer Circuits; Color Demodulation; Matrix Section; Color Picture Tube & Associated Circuits; Setup Procedure; Aligning the Color Receiver; Troubleshooting. Includes invaluable full-color picture tube photos. 224 pages; 8½ x 11". Order TVC-2, *only* $5.95

Color TV Trouble Clues

A "must" for every service technician. Outlines trouble clues and procedures for repair of color TV receivers of all makes. Covers types of troubles encountered, troubleshooting techniques, alignment and sync problems, convergence, etc. Includes valuable section on the use of test equipment to speed color set servicing. Fully illustrated with photographs and schematics. 96 pages; 5½ x 8½". Order COL-1, *only* $1.95

Color TV Servicing Made Easy

by Wayne Lemons. Written in "make easy" style. Takes the mystery out of color TV servicing. Introduces you to color principles and setup adjustments; thoroughly covers color circuitry, adjustments, and servicing of all color TV sets produced to date. This book will help to put you into this fast-growing, profitable service work. 128 pages, 5½ x 8½". Order CSL-1, *only* $2.95

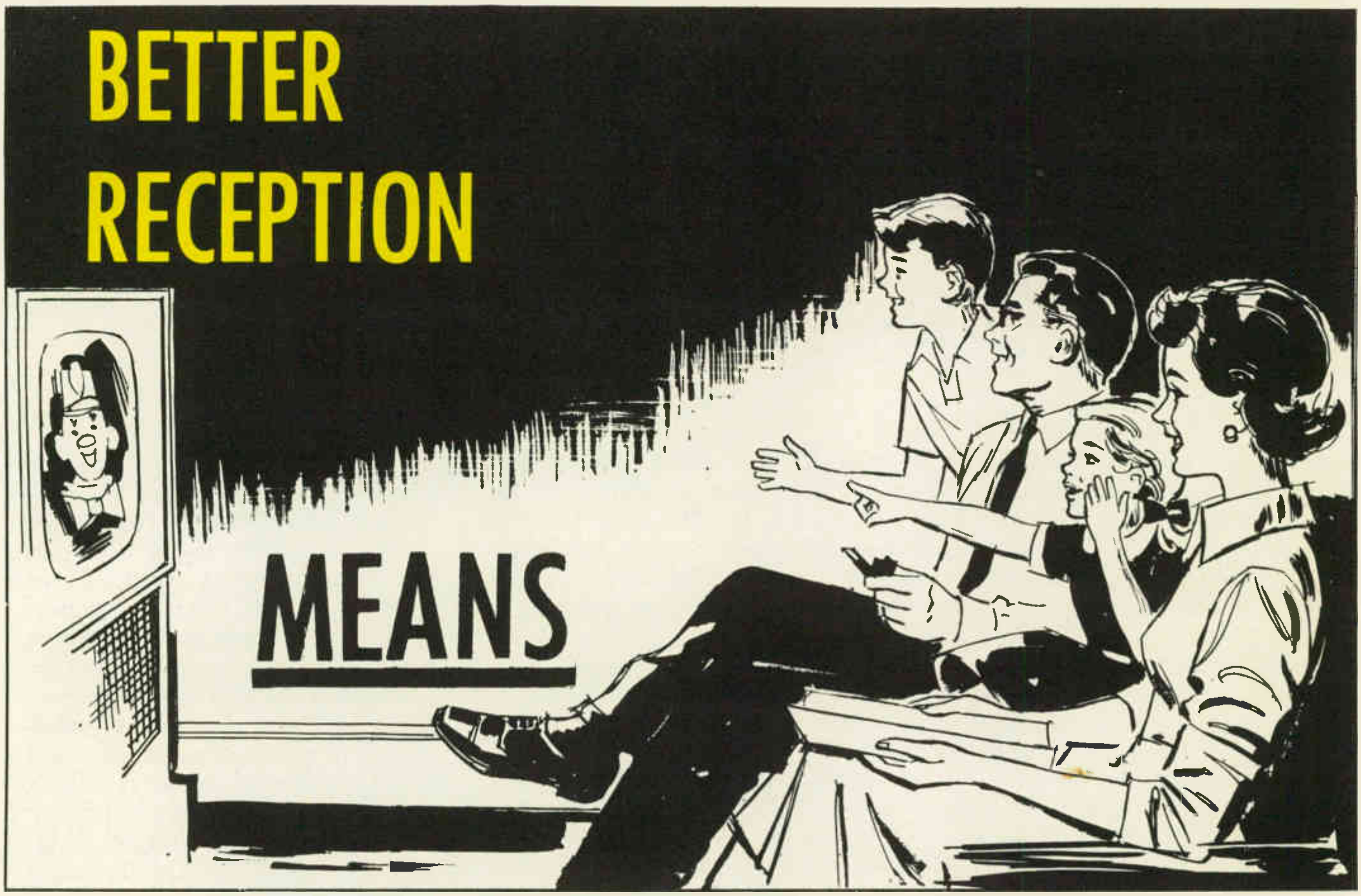
Know Your Color-TV Test Equipment

by Robert Middleton. Explains clearly and easily the function and circuit action of each Color-TV instrument—shows how to service, calibrate, and maintain it. Covers: White-Dot and Cross-Hatch Generators, Color-Pattern & Color-Bar Generators, Rainbow & NTSC Generators, Principles of Video-Frequency Sweep Generators & Testing, Lab-type equipment, and useful setup information. Profusely illustrated. 5½ x 8½". Order KOC-1, *only* $2.50

101 Ways to Use Your Color TV Test Equipment

By Robert G. Middleton. Written in the time-tested formula acclaimed by thousands of TV technicians. Shows you practically how to use test equipment to diagnose color TV circuit troubles quickly and easily. Describes proper equipment hookups, how to evaluate test results, how to check instruments; includes time-saving techniques. 144 pages; 5½ x 8½". Order TEM-9, *only* $2.50

SEE YOUR SAMS DISTRIBUTOR FOR THESE VALUABLE COLOR TV SERVICE PUBLICATIONS



MORE SALES!

IT'S AS SIMPLE AS THAT! And with ANTENNACRAFT Antennas Reception is at it's very BEST!

Just a little extra care and a little extra effort goes into Antennacraft—and it shows—in the appearance of the product and in the sharp, clear pictures on your customer's television set.

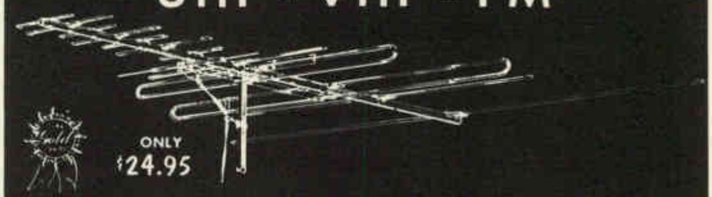
The new UHF-VHF TV sets need a combination UHF-VHF antenna to take advantage of the total programing available. Antennacraft's Channel-Spanners are all channel antennas, VHF 2 to 13 and UHF 14 to 83 and are designed to be used with these new sets with only one lead-in.

Antennacraft's Channel-Spanners produce snow-free, ghost-free pictures to the far edge of the UHF class B signal area. Maximum signal response is obtained from VHF and FM stations together with good picture quality at the class B distance and throughout the medium fringe areas.

If you are not already using Antennacraft products, contact your distributor for full information on all fine Antennacraft products. Find out for yourself how that "little extra" pays off in bigger profits for you.

FOR CHANNELS 2 TO 83

UHF - VHF - FM



ONLY $24.95

ANTENNACRAFT CHANNEL-SPANNER

ONLY $17.95

BETTER BUILT FOR BETTER PERFORMANCE

ANTENNACRAFT

Automatic Channel Selector

TV ANTENNAS

BURLINGTON, IOWA

coax for Color TV

Shielded lead-in for better pictures . . . by Lon Cantor

Color TV took off in 1964 like a rocket. But poor reception still often tethers color TV to the ground. The heart of the matter is that, in many localities, it is difficult to receive consistently good color pictures using 300-ohm twinlead. This circumstance represents an opportunity, because the technician who knows how to solve color-TV reception problems can increase his business considerably.

Talk to people who have color sets and you'll find many of them aren't entirely satisfied; they get too many "ghosts" and other interferences, and color is not consistently good or true. If they've had the set more than a year or two, their reception is probably poorer than when the installation was new. The culprit, in most of these cases, is twinlead. Now, you and your customers have been getting by with twinlead for many years; why, then, should it suddenly be declared inadequate?

The answer is color. Color reception is more demanding than is black-and-white. Rotate an antenna slowly and you'll probably find only one orientation where you get good color pictures. You may find a quite large number of orientations where the color has completely disappeared, even though black-and-white reception remains fine.

The difference is that color information, unlike the picture or sound information, contains important phase-modulated signal information. Since phase is a function of time, color signals are particularly sensitive to even the slightest time delays.

Also, viewers are more critical of color pictures. As you know, it's a lot easier to see a slight interference in the picture than to hear it in the sound. By the same token, a color variation stands out a lot more noticeably than a change in the shade of gray. The customer who barely notices a pale black-and-white ghost finds it most objectionable when it appears in living color.

Twinlead vs Coax

Coaxial downlead is nothing new. Television engineers have always thought it superior to twinlead—remember the early DuMonts, with 75-ohm inputs? And coaxial cable has always been used for professional master-antenna TV systems in hotels, motels, and apartment buildings. Why, then, did anyone ever start using twinlead in the first place? Because it was economical. Twinlead costs less than coax—at least initially.

Theoretically, twinlead works fine. But it works according to theory only when it is suspended in free air. The professional TV technician knows this, which is why he is careful to keep twinlead away from metal objects.

But aren't standoffs metal? And what about the staples you use to fasten the twinlead indoors? These metal objects do two things:

1. They cause signal losses, and
2. They cause standing waves.

Signal losses can be allowed for. What actually happens is that the standoffs and the staples and moisture (when twinlead gets wet) change the twinlead impedance. As you know, transfer of energy is maximum only when impedances are matched. If the signal is not absorbed by a matched load (the TV receiver), some of it is reflected back into the line. It is the reflected portion of the signal that causes standing waves.

Let's take a closer look to see how these reflected signals affect TV reception. Say, for example, that the twinlead is supported by a standoff halfway down. The portion of the signal that doesn't get past the standoff travels back toward the antenna. Unless it sees a perfect match at the antenna — which it doesn't—a portion once more goes back down the line to the receiver. Now, this second signal is pretty weak, but it's the same as the signal that arrived at the set a few microseconds ago, except out of phase.

TV signals travel through twinlead at slightly less than the speed of light. Thus, there is a significant time delay between the portion of the signal that traveled directly to the TV tuner and the signal that took a roundabout route. We view this delayed signal as a ghost. Because there may be many standoffs, and because signals can thus bounce around in twinlead like a yo-yo, standing waves generally cause multiple ghosts.

Actually, this situation isn't quite as bad as it sounds. The horizontal oscillator in a TV receiver sweeps the TV screen pretty fast—about once every 53 usec. But it doesn't take too long for a signal to travel an extra 100′ or 200.′ Therefore, displacement on the screen caused by reflected signals is often very slight. Furthermore, the reflected signals are often quite weak. Consequently, you may see more of a smear than an actual ghost on a black-and-white TV receiver.

With color, it's entirely a different story. Those signals bouncing around inside the twinlead are not only delayed in time but are changed in phase. This phase shift doesn't mean much to the picture signal, which is amplitude modulated. However, the color carrier is *phase modulated*. A change in phase means a change in color. Color ghosts are a lot more obvious because they're of some color different from the picture they appear beside.

Fig. 1. Twinlead under ideal conditions.

Typical Twinlead Installations

Let's look at some examples. Fig. 1 is a photo of a color TV screen. The receiver is connected to its antenna through brand-new, dry twinlead. The image looks pretty good. To get a picture like this, we had to take special pains: No standoffs or staples were used; instead, the twinlead was held away from the house with pieces of wood, and indoors was run along a baseboard for only a few feet. In other words, we've approximated the ideal conditions assumed when manufacturers give you twinlead specifications.

Fig. 2 shows the same installation, but with the twinlead connected as it normally is in the field. Five ordinary standoffs, carefully installed, were used to replace the pieces of wood. Notice the blurring of the right-hand edges of picture details. This is ringing, caused by standing waves set up by the standoffs.

Fig. 2. Twinlead, but usual installation.

The pictures in Figs. 3 and 4 are the result of a fairly common installation practice. Technicians know it's wrong, but they do it anyway. The twinlead, where it enters the house, has been pinched in an aluminum window sash — which of course sets up beautiful standing

Fig. 3. Standing waves on the twinlead.

waves, with the results shown.

For Fig. 5, we unpinched the twinlead from the window, but ran it next to the antenna mast on the roof for about 3″. This improved the picture because the reflected signals didn't actually have to travel much farther than the original signals. As you can see, the image is doubled, but very close to the main image.

At this point, we got real nasty. We left the twinlead alongside the metal mast pipe and also pinched it with the window again. This produced the really horrible picture shown in Fig. 6.

Of course, nobody would put up with a picture as bad as that shown in Fig. 6. In fact, we had to work pretty hard to produce a picture that bad. But remember, we were working with brand-new, dry twinlead. Think what will happen when, within a couple of years, the lead dries out and cracks: rain, ice, salt deposits, and just plain industrial fog can cause disastrous effects. For this reason, many color-TV set owners suffer along with poor reception every time it rains. By the time the installation is a couple of years old, their color pictures are consistently poor. When you encounter a situation like this, it's easy to sell a coaxial installation.

Advantages of Coax

One reason coaxial cable is better

Fig. 4. Lead pinched by aluminum sash.

than twinlead for color is that it is shielded (see Fig. 7). The shielding makes coax impervious to its surroundings. You can tape it to a mast; run it underwater, alongside power lines, next to pipes, or through metal windows; coil it in a ball; almost anything. The only thing you can't safely do is crush it, because that changes the spacing between the inner conductor and the outer conductor (the braided shield), which in turn changes the impedance.

Fig. 5. Lead too close to antenna mast.

The coaxial cable most commonly used for TV is RG-59/U, which has an impedance of 75 ohms. RG-59/U is very rugged, lasting many times longer than twinlead. Furthermore, it won't pick up interference from auto ignition or home appliances.

Fig. 6. About every mistake in the book.

Another nice thing about coax is that it won't pick up any TV signals directly. This is especially important in metropolitan areas. Take New York City, for example. There are so many tall buildings that you get signals bouncing in from all directions. In many cases, you have to turn your antenna away from the transmitter and aim it toward a nice, clean, uncomplicated reflected signal. The trouble is that, while the antenna may be directive enough to pick up only the reflected signal you aim at, the twinlead is not. It picks up all the signals, with the direct-from-transmitter signal being the strongest. Thus, it's nearly impossible to get rid of ghosts in such localities except by using coax.

To summarize, coaxial cable compares with twinlead as follows:

1. It always maintains its 75-ohm impedance, regardless of surroundings. Thus, there are no standing waves to produce ghosts and color changes.
2. It won't pick up interference such as from auto ignition or appliances.
3. It is impervious to weather conditions. (Twinlead loss increases by as much as six times when it is wet, and even a heavy dew can ruin twinlead matching.)
4. It is stronger than twinlead—can take more strain and abuse.

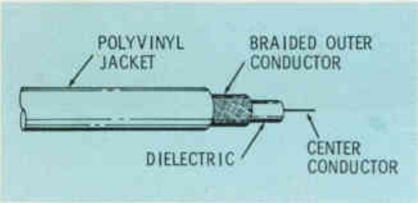


Fig. 7. Construction of coaxial lead-in.

Coax is also easier to run. You don't have to use standoffs or keep it away from metal. And you can coil the excess coax up behind the TV set with no fear of picture deterioration.

5. Coax costs more initially, but it's cheaper in the long run. Twinlead deteriorates many times faster than coax.
6. Coax is a natural for color installations, not only because color reception is more critical but because the man who pays $400 for a color set is usually willing to invest a little more for better pictures.

Matching Coax

Once you decide to use coax, you run into a slight problem. Coax has a characteristic impedance of 75 ohms, but most TV sets and antennas are matched to 300 ohms. As color becomes more widespread, this situation may change. Some manufacturers are already marketing antennas for 75 ohms (see Fig. 8) and color-set manufacturers may eventually follow with 75-ohm inputs for tuners.

In the meantime, though, you have to use matching transformers for most installations. There are two basic types of matching transformers—indoor and outdoor. The

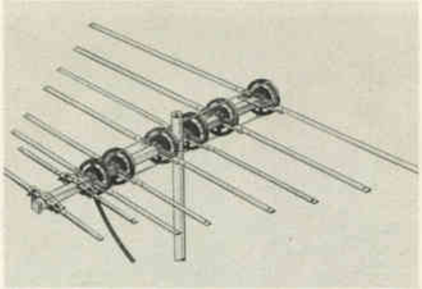


Fig. 8. This antenna takes 75-ohm lead.

outdoor unit is weatherproof, so it can be mast-mounted as near as possible to the antenna so the twinlead between antenna and transformer is short as possible (Fig. 9). An indoor matching transformer (Fig. 10) mounts right on the TV set. In really strong signal areas, or where interference is heavy, it may even be advisable to mount the matching transformer inside the TV set, connecting it directly to the tuner.

Fig. 9. Mast-mount transformer match.

For convenience, one manufacturer has packaged an indoor and an outdoor matching transformer together in a kit (see Fig. 10). Coaxial cable is also being marketed in precut lengths, with fittings attached. Many technicians shy away from coax just because they don't know how to make fittings. Actually, it's quite simple, as shown in Box 1. But prefitted cable removes even this slight obstacle.

What kind of pictures can we get with coax? Fig. 11 is taken from the same TV set in the same house as the earlier pictures. The downlead was taped to the mast in three places, stapled to the house with heavy iron fence staples, taken

Fig. 10. Indoor transformer on TV set.

through an aluminum window, stapled along the wall, and then 25′ of it taped together in a tight coil behind the TV set. The reason the picture is so good, despite all these sins, is that the downlead is RG-59/U coax. This installation not only provides good color pictures, but it will last for years.

Cash In On Coax

The first thing you should do to cash in on coax is to become familiar with its use. Make a couple of coax color installations to convince yourself how effective coax can be and to get an idea of the costs and time involved.

Then, offer your service to every dealer who sells color sets in your area. In talking to these people, you'll find that some of them have had trouble satisfying certain color customers, once the set has been delivered. If you can convince them you have a new, up-to-date method of insuring consistent color pictures, you'll find them anxious to cooperate.

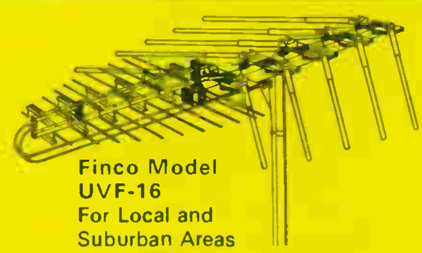
Fig. 11. Color obtained from coax lead.

Conversion of existing installations can also be lucrative. Suggest a coax conversion to the owner of each color set you service. If there is a good local color dealer or distributor, try to work with him on a direct-mail campaign to color-set owners.

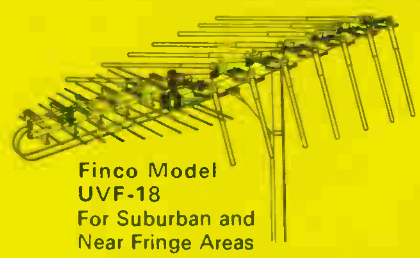
Don't overlook the possibility of selling TV signal boosters along with coax installations. Because color operation demands stronger signals, boosters can provide tremendous improvements in difficult signal areas. A number of manufacturers have recently introduced boosters that match coaxial cable.

The concept of coax for color can be profitable. All you have to do is take the time to understand why coax is better for color—and then promote it aggressively. ▲

Finco Model
UVF-10
For Metropolitan Areas
List $18.50



Finco Model
UVF-16
For Local and Suburban Areas
List $30.50



Finco Model
UVF-18
For Suburban and Near Fringe Areas
List $42.50

A major breakthrough in Antenna design!

FINCO

ALL BAND
UHF•VHF•FM
"COLOR VE-LOG"

Featuring Finco's Exclusive Gold Corodizing

Finco Model
UVF-24
For Near Fringe and Deep Fringe Areas
List $59.95

Finco's new All-Band Color Ve-Log Antenna does the work of three — gives startlingly clear black and white pictures and beautiful color on *both* UHF and VHF television channels. Its superlative design also assures the finest in stereophonic and monophonic FM sound reproduction. Comparison tests have proved the superiority of the All-Band UVF Series — superiority backed by Finco's guarantee of supremacy and unquestioned warranty.

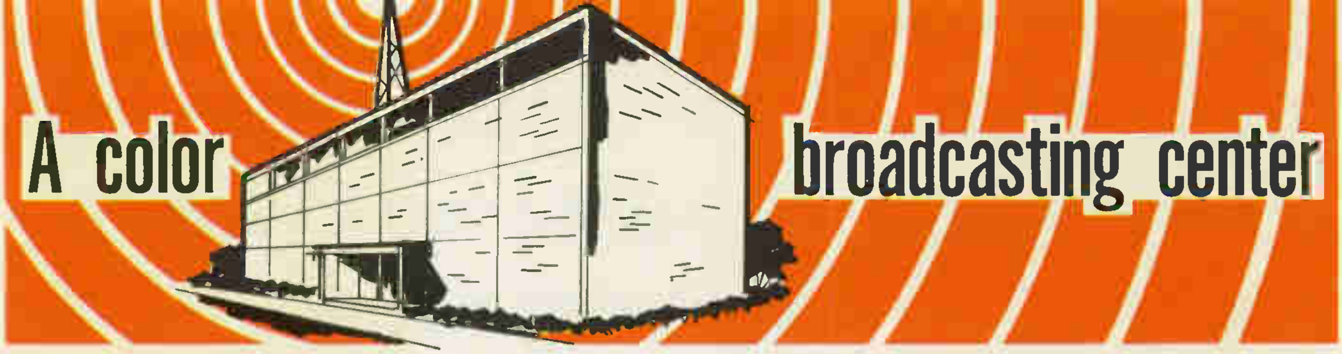
UVF Color Ve-Log Antennas . . . Engineered for the future!

- Revolutionary new UHF Section
- Heavy Aluminum reinforced insulator insert cup and heavy duty rivet
- Back-up bracket and square boom
- Finco's exclusive triple thick sleeved elements
- Lock-tite no-tilt saddle bracket
- Finco's exclusive double contact to drive line
- Continuous one-piece drive line and exclusive air insulated polystyrene cross-over spacer

Prices and specifications subject to change without notice.

THE FINNEY COMPANY • 34 W. Interstate Street • Bedford, Ohio

Write for beautiful color brochure Number 20-322, Dept. 310



A color broadcasting center

Tour of the NBC complex in New York

by George C. Sitts

The basic theory behind color transmission is familiar to most television servicemen. An image is picked up by a lens and split by a prism into three separate images. Each of these images is passed through a colored filter of either red, blue, or green, where it is focused on a pickup tube in a camera head. The camera head outputs, representing the red, blue, and green portions of the picture, are fed to a colorplexer, which converts the three signals to one standard NTSC color signal. This signal is then transmitted over normally black and white transmission facilities to the home receiver.

Even a brief review of this basic theory suggests several variables that must be adjusted to allow transmission of consistently good, uniform color pictures. The original image may have nonstandard coloring, the three video signals may not be registered (converged) properly, or they may be of uneven values. The colorplexer may not be phased properly, thus requiring wide variation in receiver tint-control settings. The network lines or the transmitting station facilities may impair the input signal before it is transmitted. Any of these malfunctions deteriorate the color quality and are possible causes for servicing headaches when you are looking for in-set troubles that are actually originating troubles.

With this in mind, we called on Bill Howard, Project Engineer for NBC, to find out how a network with over ten years of color transmission under its belt manages to constantly feed a uniform, high-quality color signal to its affiliated stations. It was apparent from our tour of the NBC facilities in New York City and our discussions with its employees that good color transmission is based on careful attention to detail all the way from the stage to the affiliate station.

Studio 8H prepared to tape color show.

Lighting

The care begins when NBC studio crews light the production set with three necessities in mind. First, they strive for a pleasing photographic effect, both in black and white and in color; thus they use various intensities of lights from each direction. Second, they work for the proper overall light intensity, which assures uniform lighting from set to set as well as sufficient illumination to produce good color images. The light intensity varies somewhat, but it is presently in the range of 300′ candles. Third, they check the set for proper color temperature. This check assures that the lights will not give a red or blue cast to the electronic image. If lighting changes are to be made during the show, the crew checks the lights for intensity and color temperature. An organ-like console in the lighting booth controls the studio lights; the lighting director adjusts the stops and dimmers to obtain the exact desired effects.

Projectionist loads a 35-mm film reel on one of many projection islands.

Color Cameras

The typical color show uses three or four color cameras which go through an elaborate preshow alignment. First, the colorplexer of each camera is aligned using a color-bar signal and a vectorscope; this is done to obtain a standard red-blue-green balance in the outgoing signal. Second, the colorplexer is checked with and adjusted to match the network's standard colorplexer. Next the cameras themselves are aligned by using several transparent test patterns. The first of the test patterns allows the aspect ratio of three high by four wide to be adjusted on each of the three camera heads in each camera. Then each camera head is electrically adjusted to bring it into registration, a network term for convergence. This is accomplished by using the green camera head as a base and adjusting the red and blue camera heads into registration with it. Adjustments used are horizontal and vertical linearity and centering, height, and width. Any picture tilt is adjusted by mechanical repositioning of the yoke on the troublesome camera tube.

Once the cameras are brought into registration, color balancing begins. A camera is focused on a ten-step gray scale test chart, and the outputs of the individual camera heads are viewed on an oscilloscope. Because the gray scale strips are carefully selected, the resulting output waveform is ideally a stairstep

Film video-control operators monitor output of each film pickup camera.

signal with ten evenly spaced markers from black to white. Any variations in the individual camera heads from a straight stairstep waveform can be adjusted by a gamma-corrector control. This process of gamma correction assures that the camera will faithfully track from black to white. Without it, a camera could have good black and good white, and the grays between could be tinted by one of the colors.

Thus far, all adjustments and comparisons have been made to black and white test transparencies; the theory is that if the camera puts out good black and white, it will put out good color. However, as any serviceman who works with color receivers knows, it is difficult to judge true black and white free of any blue, green, or red. Therefore, NBC makes a final adjustment for good flesh tones. This is done with a live model on the set and under the same lighting conditions that are to be used in the color show. All the cameras are focused on the model, and they are "touched up" electronically to produce pleasing and matching flesh tones on all cameras.

At this point, the cameras are ready for rehearsal, which generally takes place immediately before each show. However, there is usually a one-half hour gap following the rehearsal before the show; during this time, any discrepancies can be corrected in the cameras, and the cameras's colorplexer can be rechecked against the network standard. Once the show begins, only the pedestal (brightness) and gain (contrast) controls are adjusted by the video operators.

Operating Staff

To assure a smooth running and good looking show, NBC uses a large, specialized staff. The director is the authority in the control room; he gives orders for all action that takes place. This includes ordering lighting changes, video switches, camera movements, film rolls, audio adjustments, and cues to the performing talent. He is assisted by a script girl who keeps an eye on the script, times various segments, and warns the director of upcoming events.

The technical director is the highest in rank of the operating personnel. He does the actual switching, fading, and dissolving between cameras, films, and video tapes. He also gives the directions to the camera operators and audio operators.

The chief video operator supervises the video output for each camera. It is his responsibility to see that the cameras are matched for color and that the levels of the cameras are properly adjusted during the show. He is also responsible for correctly keying electronic special effects, such as matted and keyed titles.

The audio director adjusts mike levels and recorded inputs as he receives cues from the director. He also is supervisor of audio operators, including boom-mike operators and those who assist in cueing records and tapes.

The camera operators, who are directly under the supervision of the technical director, sit or stand behind the cameras. In many shows, particularly panel and quiz shows,

Video-tape operators check out each video-tape machine before it is used.

actual camera movement is kept to a minimum; the effect of movement is produced by side to side pans of the camera and by the use of zoom lenses. In general, stationary cameras make lighting easier and minimize problems with cables on the floor. Besides haveing a script cue for each camera shot, the camera operators receive orders via headset intercoms from the technical director to pan, tilt, zoom, and focus. Because he has no control over the color content, the cameraman sees his shot on a black and white viewfinder monitor on the camera.

Video Tape Recording

As a show takes place, it is recorded on video tape for playing in its allotted time slot. Only a few shows, notably sports and news events, are run live. When a show is scheduled for video taping, it may be recorded on as many as six video tape recorders simultaneously.

Video-tape control operator prepares to roll and switch an upcoming show.

An input selector switch on each VTR allows the operator to record directly from the output of the various studios. When taping is completed, the best tape copy of the show is selected, and several duplicates are made. Immediately preceding the scheduled playback time, at least two VTR's are carefully checked out, using the test tape of a color-bar signal that can be compared to the network standard for uniformity. Also at this time, any head banding, (i.e., horizontal bars of color variations) is tuned out.

The outputs of all VTR's are connected to a common video-tape control center. When the show is aired, at least two copies are run simultaneously. Thus, if one fails, the tape-control operator can simply switch to the protection copy. The tape-control operator is also responsible for the rolling and switching of the VTR's to various lines leading to the network's master control.

The VTR's themselves are grouped in islands of two, with one video-tape operator per island. It is his job to see that the machines are ready to record on schedule, that they are operating properly while recording and playing back, and that their output signals are correct. A VTR supervisor is responsible for scheduling more than 20 VTR's to assignments, as well as overseeing

Rehearsing commercial—Tonight Show.

Film director, film technical director, and audio operator air a film show.

the entire video-tape operation.

Film Cameras

A high percentage of NBC color shows originate from film; thus, the film operations are also a major part of the network's headquarters. Film transmission begins at the projector. NBC uses 35-millimeter film as their main source with a 16-millimeter print as a projection copy running simultaneously on a second projector. The image is projected into a color film pickup camera that,

Projectors receive periodic attention. Camera heads exposed on the right.

except for using vidicon pickup tubes in place of image orthicon tubes, varies little from the color studio cameras.

The projection area is arranged in islands containing a 35-millimeter and a 16-millimeter film projector, a 2″ x 2″ slide projector, an optical multiplexer, and a color film pickup camera. The color camera and all the projectors are focused into the optical multiplexer in the center. A system of adjustable mirrors permits the film-control operator to select which image is to enter the color camera lens. The six islands in each room are connected to a film-control center, which is located in a separate room to isolate it from the projector noise.

Before a film show is run, each film camera chain is aligned and checked against the network standard as the "live" cameras were. Also, the projectors are focused, and the lamp voltages are adjusted to give light of the proper color temperature.

Air Time

Several people are involved in the actual airing of a film show. The film director, located in the film-control center, is responsible for all coordination. He sees that the film and cameras are ready for transmission, gives the roll and switch orders, and keeps track of timing. The film technical director does the ac-

An aired video-tape show receives simultaneous playback on two VTR's.

tual rolling and switching to the director's cues. An audio operator adjusts the audio levels. A film video-control operator is assigned to each camera control; he adjusts the pedestal (brightness) and gain (contrast) to maintain standard and pleasing levels through the show. The projectionist at each projection island stands by to make any needed corrections during the show. These corrections include cleaning stubborn dirt from the picture, touching

Master control engineer adjusts test signals in preparation for network test.

up focus, replacing blown lamps, or catching a "lost loop" or a slipping film.

When an all film show is run, it is controlled from any one of three film-control centers. However, if a film insert, such as a commercial, is to be added to a "live" show or a video-taped show, the film is controlled from any one of three "live" studio control rooms.

Color Broadcasting Center

When a show is to originate from a combination of video tape and film or from several films or several video tapes the entire show is run in a rehearsal a few hours before air time. This rehearsal allows the director to check the overall timing and to watch for cue lines for change-overs or commercial inserts. The rehearsal run also lets the audio and video operators note any sudden variations in levels for which they must compensate when the show is aired.

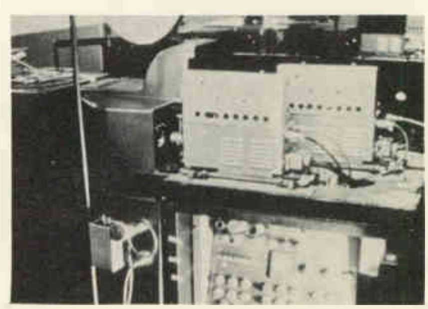
Technical Operations

Up to this point, the preparations for live, taped, and filmed shows have been reviewed. When a show is actually put on the air, the outputs of the live studio, video tape, and/or film-control centers are fed to the network's master control center. Master control is responsible for switching the proper signal to the

Monitors show input and "round robin" signals. Switcher times various events.

proper network outgoing line at the proper time. It also has the responsibility of seeing that the affiliated stations receive a standard, unimpaired signal, both video and audio.

Switching of the signals to the various lines is accomplished by a preset timer. The master control operator selects the upcoming event on a switcher; he then sets a timer to the hour that the event is to be switched. At the preselected time,



Color-film camera heads, some camera head controls are shown below.

Before a show, each camera is aligned with the use of a gray-scale slide.

the audio and video sources selected are switched to the proper network lines.

Calibration of Equipment

The main network routes include a "round-robin" loop of nearly 3000 miles that goes from New York through the mid-Atlantic states, west to Missouri, back through Michigan and the northeastern states, and finally returns to the network's master control in New York. The outgoing and returning signals are then displayed side by side on video and waveform monitors, thereby allowing the master control operators to constantly monitor a major pattern of the network lines.

The condition of the video lines is not only checked by picture quality but also by continuous use of vertical interval test signals and by regular, full-picture test signals during nonbroadcast periods. The vertical interval test signals are the white bars and dots which appear in the black at the top of home receiver pictures during network shows. Three separate vertical interval test signals are used, and each one is automatically keyed in for two minutes.

The first type is the multiburst signal, which allows a convenient check on overall transmitted bandwidth. The signal consists of several cycles of each of six frequencies transmitted at equal levels, all in the same horizontal line. They appear on a video monitor or home set as a series of unevenly spaced white dots in the vertical interval. The six frequencies used are 0.5, 1.5, 2.0, 2.9, 3.6, and 4.0 megacycles.

The second signal, or the modulated stairstep, is the gray scale signal mentioned previously; modulated by a 3.5-megacycvle sine wave. The signal appears in the vertical interval as a series of varying bright dashes ranging from black on the left of the screen to white on the right. This signal is useful to the network for measuring black and white compression and to the serviceman for adjusting brightness and contrast for a complete range of black to white.

The third signal, or window pulse, is essentially a square wave. It is used by the network to measure streaking and frequency response. The signal appears in the vertical interval as a long white dash.

The full picture test signals used

Overall master control consoles, not showing the "round robin" monitors.

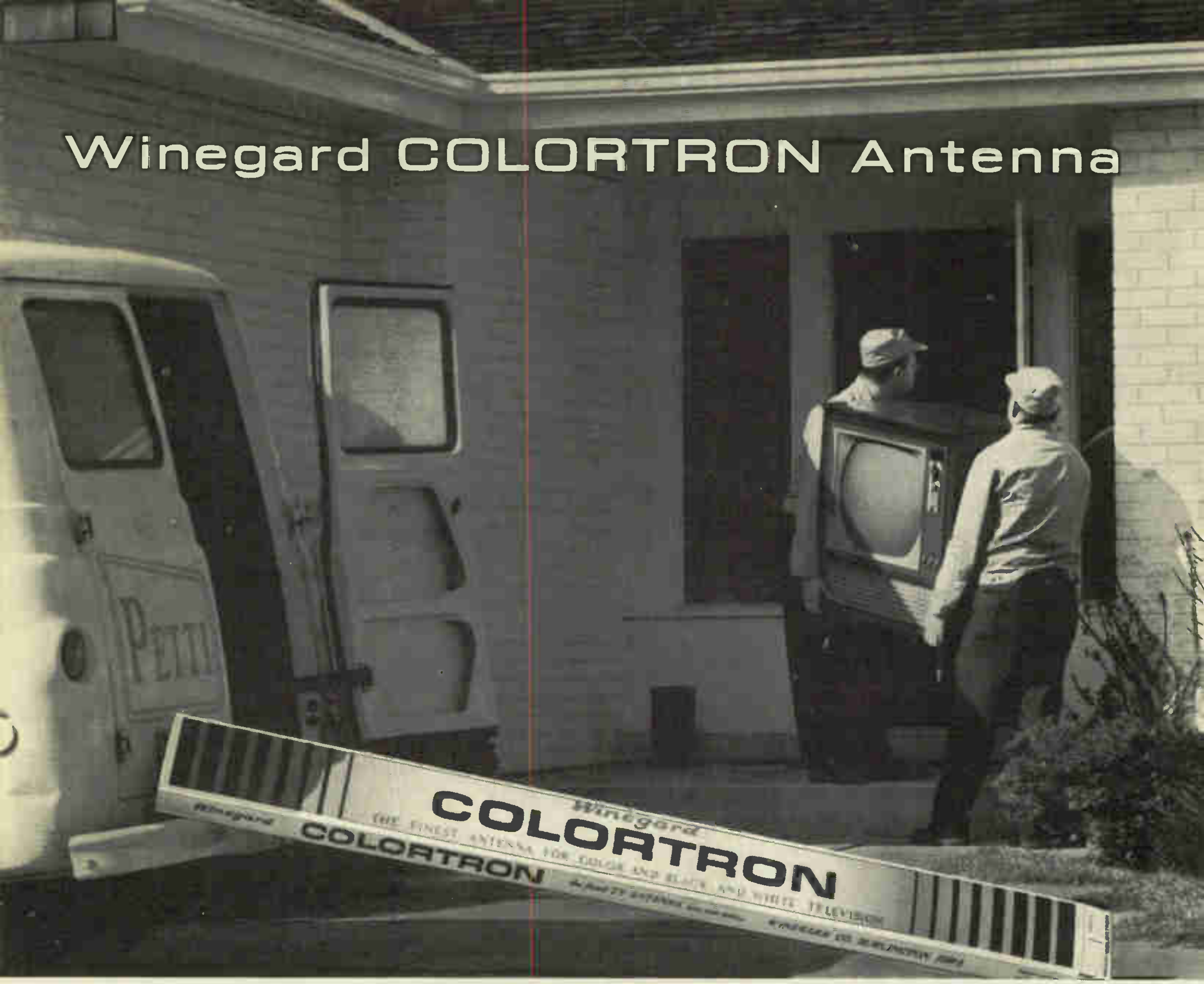
Lighting console gives great versatility in changing lighting during show.

during nonbroadcast periods are, of course, not visible to the serviceman. They are used to give a more complete check of the system and to make the troubles that are best shown on a video monitor more easily viewed. The full picture signals include all the vertical interval signals as well as one additional signal—the sine squared. This is a short white pulse used to measure ringing in the network lines.

One night each week the full picture test signals are viewed by the network and about 50 of the network affiliates. At this time, two pictures of each waveform are taken with Polaroid cameras. Any serious troubles are reported immediately by phone, and one copy of each photo is submitted to the manager of network transmission. The second copy is submitted to the local A.T.&T. office. Thus any signal impairment from week to week can be observed, pinpointed, and corrected.

This system of checking and perfecting color facilities has taken NBC over ten years to develop. Therefore it is only natural that the NBC staff feels that color shows are standard procedure and that black and white shows are only remnants of the early days of television ▲

Winegard COLORTRON Antenna



The Colortron Antenna's "BALANCED DESIGN" is the Winegard secret of superior color reception!

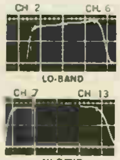
It takes a combination of high gain, accurate impedance match, complete band width and pinpoint directivity to make the perfect color antenna. Only the Winegard Colortron gives you all 4 with BALANCED DESIGN.

What is Balanced Design? It's not enough to design an antenna for high gain alone and expect good color reception. A high gain antenna without *accurate impedance match* is ineffective. Or an antenna with *good band width* but *poor directivity characteristics* is unsuitable for color. The Winegard Colortron is the one antenna with *balanced design*, excellence in *all* the important characteristics that a good color antenna requires.

For example:

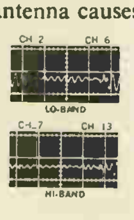
Gain and Bandwidth—A superior color antenna must have high gain and complete bandwidth as well. But the response must be *flat* if it is to be effective. Peaks and valleys in the curve of a high gain antenna can result in acceptable color on one channel and poor color on another.

No all-channel VHF-TV antenna has more gain with complete bandwidth across each and every channel than the Colortron. Look at the Colortron frequency response in this oscilloscope photo. Note the consistent high gain in *all* channels. Note the absence of suck-outs and roll-off on end channels. The flat portion of the curve extends on the low band from the channel 2 picture carrier past the channel 6 sound carrier. On the high band, it is flat from the channel 7 picture carrier to the channel 13 sound carrier. There is less than ½ DB variance over any channel.



Impedance Match—the two 300 ohm "T" matched Colortron driven elements have far better impedance match than *any* antenna using multiple 75 ohm driven elements. The Colortron transfers *maximum* signal to the line without loss or phase distortion through mismatch. Winegard's "T" matched driven elements cost more to make, but we know the precision results are well worth the added manufacturing expense . . . because a mismatched antenna causes loss of picture quality which *might* get by in black & white, but becomes highly disturbing in color.

The oscilloscope photo here shows the Colortron VSWR curve (impedance match). No current VHF-TV antenna compares with it across all 12 channels.



Directivity—Equally important for superior color pictures is freedom from interference and ghosts. Therefore, an antenna with sharp directivity and good signal-to-noise characteristics is necessary. Extraneous signals picked up at the back and sides produce objectionable noise and ghosts in black and white reception . . . frequently ruin color reception.

Winegard's Colortron has the most ideal directivity pattern of any all channel VHF antenna made. It has no spurious side or large back lobes . . . is absolutely dead on both sides. Colortron does not pick up extraneous signals, and even has a higher front-to-back ratio than a single channel yagi.

TYPICAL CHANNEL

Look at this Colortron polar pattern. No other VHF-TV antenna has sharper directivity on a channel-for-channel comparison.

BALANCED DESIGN COLORTRONS HAVE SUPERIOR MECHANICAL FEATURES, TOO!

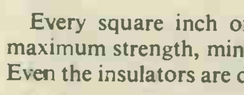
Every square inch of the Colortron has been engineered for maximum strength, minimum weight and minimum wind loading. Even the insulators are designed for low wind resistance. The result is a streamlined, lightweight antenna that stays stronger longer. Colortrons have been wind tested to 100 mph.

Colortrons are simpler to put up, too. Easier to carry up a ladder and mount on a high mast. No extra weight and bulk to frustrate the antenna installer.

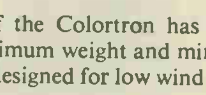
And, you can see the difference in quality when you examine a Winegard COLORTRON. The GOLD ANODIZED finish is bright weather-proof gold that *won't fade*, rust or corrode. It's the same finish specified by the Navy for military antennas. Full attention is paid to every detail.

Winegard Helps You Sell—does more national advertising *than all other brands combined.* When you sell Winegard, you sell a brand your customer knows . . . backed by a *written factory guarantee of satisfaction.*

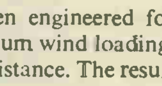
It's not surprising that Winegard leads the field in the number of antennas installed with color sets. And Colortrons have been installed by the hundreds of thousands for black and white sets too —for the antenna that's best for color is best for black and white as well. Why don't you try a *balanced design* Colortron and see for yourself?



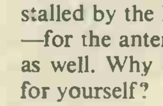
COLORTRON ANTENNA
Model C-44 • Gold Anodized • $64.95



COLORTRON ANTENNA
Model C-43 • Gold Anodized • $51.90



COLORTRON ANTENNA
Model C-42 • Gold Anodized • $34.95



COLORTRON ANTENNA
Model C-41 • Gold Anodized • $24.95

Winegard Co.

3009-F KIRKWOOD • BURLINGTON, IOWA

New developments in color CCTV

Industry finds natural color a distinct help.

by Joe Risse

The use of color in closed-circuit television (CCTV) applications has steadily increased at almost the same rate as the purchase of color-TV receivers by the general public. In industry, education, and other applications, a color TV system is installed only if a monochrome system won't serve the purpose. A deterrent, of course, has been cost. Also, physical requirements for a color system are greater. In other instances, limited space, bulkiness, and weight have ruled out color. But cost, weight, and size are on the downtrend due to improvements and new developments in vidicon color cameras, two-color systems, more compact color monitors, non-NTSC systems, non standard color monitor tubes, etc.

A new monitor (Fig. 1) produced by Conrac Division of Giannini Controls Corporation, employs 17 tubes, 87 transistors, and 35 diodes. Its use of the Hitachi shadow-mask tube shows the trend toward compactness. This monitor, for table, stand, or 19″ rack mountings, is available also in 21″ and special industrial models.

Improved video tape equipment has made possible rental of or subscription to color video tape programs. Thus, video tape has helped increase the use of color monitors and receivers, and has eliminated the need to purchase cameras or film chains capable of color pickup.

While many color-CCTV systems are installed and maintained by manufacturers, field-service engineers and technicians, or by development-laboratory engineers and industrial or university scientists, more and more are being designed and installed as "building-block" systems by local specialists in CCTV. In most cases, consultants, development engineers, scientists, representatives, and manufacturers have neither time nor desire to troubleshoot and service these systems once they are operating.

Opportunities in color CCTV are growing. Write to the manufacturers of color-CCTV equipment to obtain the names of their area representatives. It is quite possible these men are looking for someone with your qualifications. You will need a thorough basic knowledge of TV principles, color principles, be able to handle test equipment, and analyze nonroutine troubles. Your chances of obtaining a service contract will improve considerably if you are familiar with the application of their particular color system. If you are not, be willing to familiarize yourself with the technology involved—it might be optics, chemistry, spectroscopy, textiles, art, biology, geophysics, pyrometry, or what have you. The user of the color-CCTV systems might be able to recommend reference books.

Types of Systems

A survey of some of the types of color-CCTV systems now in use, some of the latest applications, and some of the trends in the industry will be helpful to you.

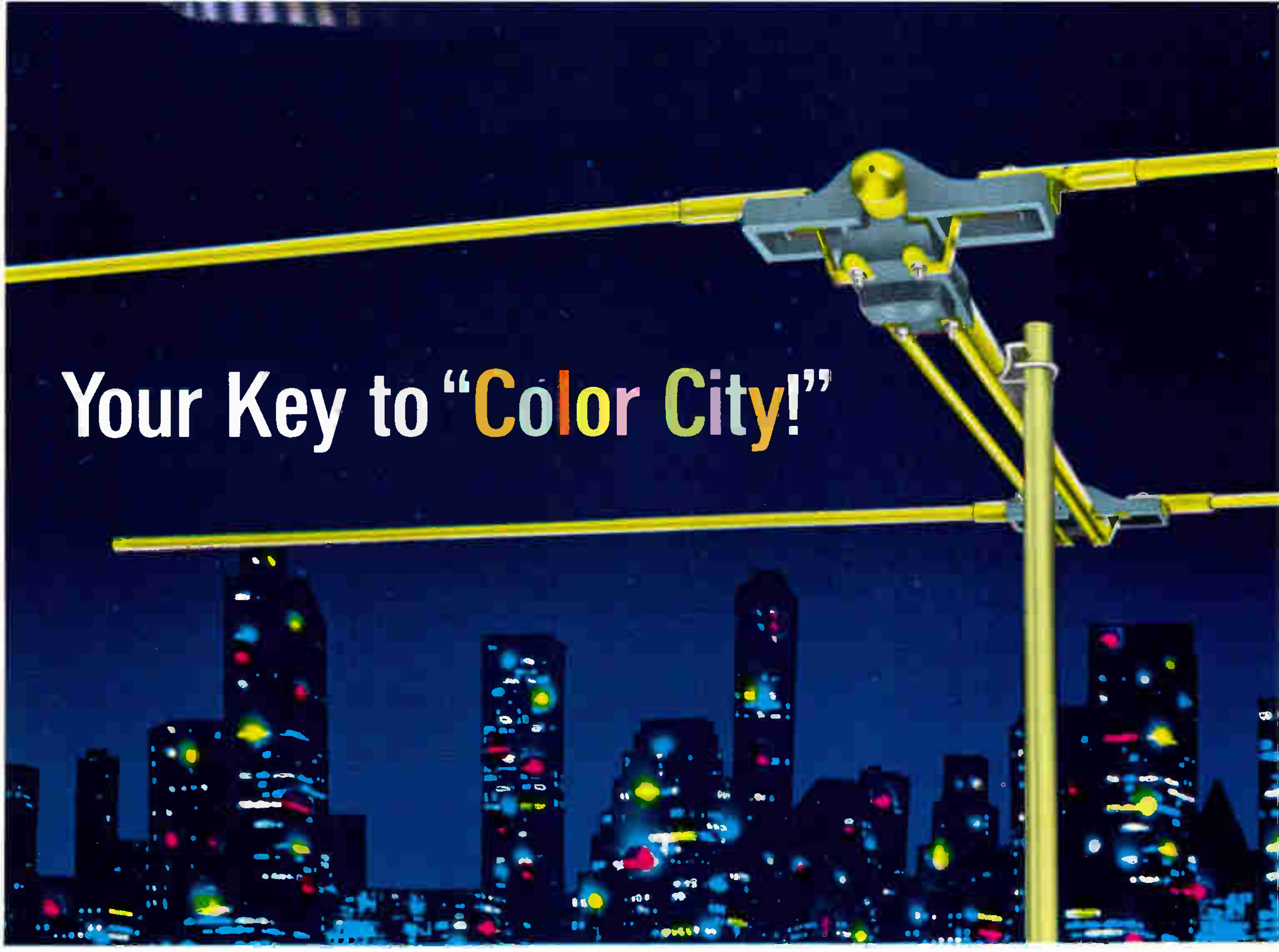
Uses of noncommercial broadcast color TV systems are classed as open-circuit and closed-circuit systems. Open-circuit noncommercial TV is broadcast mostly by educational or experimental TV stations for special temporary needs. In both, however, use of color is infrequent.

Closed-circuit color is more common. These systems are basically either standard NTSC systems or one of several types of nonstandard or modified system. Also, some include equipment for conversion of foreign (SECAM and PAL systems) color signals to U.S. systems; these have appeared with the advent of international exchanges of tapes and transmission, or relay, by satellites.

Medical Applications

One of the earliest major uses of color CCTV was by Smith Kline and French laboratories for transmission of surgery programs to doctors and interns. This made it possible for larger numbers of students and surgeons to witness an actual

Fig. 1. Conrac CYA17 color monitor.



Model 3110-G

A new kind of ghost-killing antenna. Tailored to the Color Age. With a Power Equalizer Circuit that makes every other so-called metropolitan color antenna look pale by contrast.

Color is going over the top this year. More color sets than ever are being sold.

Ghosting—not gain—is the big problem in metropolitan areas, of course. And ghosts are even more trouble in color than in black-and-white.

Channel Master's Coloray licks *both* reception problems handily. It's honestly unique. Why? Because it's the most powerful antenna ever designed to knock out ghosts and interference—in black-and-white *and* color. It has a revolutionary Power Equalizer Circuit (which provides higher front-to-back ratio than 10-element yagis cut to each specific channel). Thus its ghost-killing power in color is extraordinary. *Obviously ghosts in black-and-white are a pushover.*

What makes us so cocksure? Thousands of installations throughout the country. Time after time, they've proved the Coloray's ghost-killing ability. And in places where all other antennas have failed.

The Coloray puts the key to "Color City" in your hands. Use it to open the door to tremendous new sales.

- *Front-to-back ratios up to 30 to 1.*
- Protected by exclusive E.P.C. "Golden Overcoat."

What other antenna dares offer this unique guarantee!

Coloray antennas are GUARANTEED to eliminate or minimize ghosts better than any other antenna type regardless of size or price OR YOUR MONEY BACK

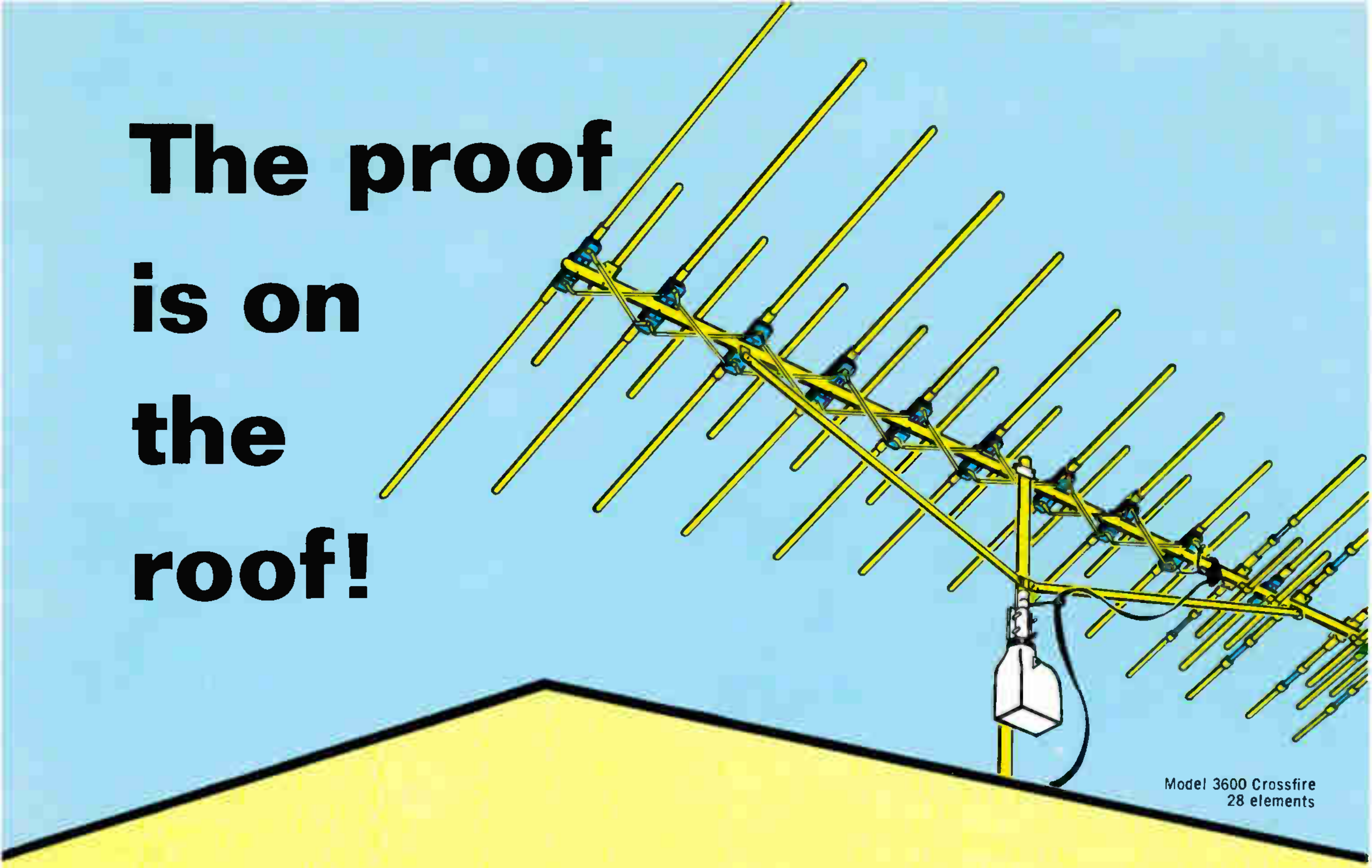
CHANNEL MASTER

VHF/FM STEREO BROADBAND

COLORAY*

*Pat. Pending

The proof is on the roof!



Model 3600 Crossfire
28 elements

CHANNEL MASTER Crossfire

outperforms, outlasts, and outsells every other antenna in the history of TV.

In America's suburbs...fringes...far fringes...in COLOR, black-and-white, FM/stereo

People spend upward of $350 just so they can enjoy color TV.

So doesn't it stand to reason that they would want the antenna that is capable of bringing out the best in their color set?

Sure it does. That's why...from metropolitan areas on out...the most powerful broadband antenna you can sell is the Channel Master Golden Crossfire. For both color *and* black-and-white.

By actual count, there are more Crossfire installations in America than any other antenna. The Crossfire, in fact, is the largest-selling antenna in the world. Why?

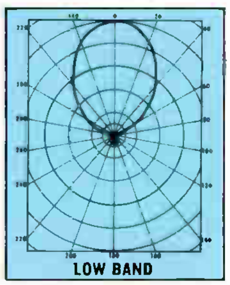
Proportional Energy Absorption! The Crossfire alone employs this unique principle. Because it has more driven elements working with greater efficiency than any other antenna... it delivers the highest antenna gain of all time. On each high band and low band channel—and FM Stereo.

No color "suckouts" or dips! Flat gain. Perfect impedance match assures absolute minimum of variations on each channel.

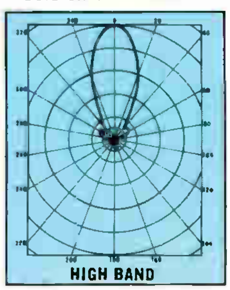
Outlasts all others! Super-rugged design and construction means extra durability. Exclusive E.P.C. "Golden Overcoat" protects against corrosion.

For color and for black-and-white, cover your market with the Crossfire—and you color your cash register green.

Clean Gain, too!



Extremely high front-to-back ratios...up to 16:1 on each band.



To fit every area need... Channel Master makes a complete line of Crossfires (including one with a built-in booster). Plus a complete line of super-powered Booster-Couplers... and Super-Torque Rotators (automatic and manual).

Fig. 2. Video Tape and audio equipment at Bradley University Installation.

operation from outside the operating room.

Another large color system, installed by RCA in 1955-1956, linked Walter Reed Army Hospital, Walter Reed Army Institute of Research, and Armed Forces Institute of Pathology, all in Washington, D. C., in a three-channel hookup using seven color cameras.

Doctors' training is still one of the main uses for color CCTV. The viewer has a surgeon's view of the proceedings; here color is essential.

A vidicon color camera by Marconi was installed at St. Johns Hospital, Chelmsford, England, about a year ago. The camera, specially designed for medical uses, is remote controlled, can be used with turret or zoom lenses, is lightweight and compact, and is airtight and pressurized to prevent the possibility of explosion due to anesthetics. It is also adaptable to microscopes and endoscopes.

The most recent large-scale open-circuit (but not viewed by the general public) system now operates in Hartford, Connecticut; programs are sent out over Hartford's channel 18 subscription-TV station. The broadcast signal can be received on all home TV sets, but can be unscrambled only by doctors having special decoders built by Zenith Radio Corp. Decoders of regular subscribers to the subscription service will not unscramble the picture intended for the doctors, thus the information can be entirely private.

This medical educational system operates regularly; programs have included lectures and events taped in color from the Western Infirmary, Glasgow, Scotland, and from The Mayo Clinic, Rochester, Minnesota. Topics covered have included hyperbaric oxygen, emotional problems, and cardiac-anomalies surgery. Others will include courses, clinics, symposia, and analyses of recent significant medical developments.

A new large medical and educational color CCTV system has been installed at Bradley University, Peoria, Illinois; the system was designed and installed by Ray Benck, Medicom, Inc., comunications consultant. This system is equipped with video tape recorder and live cameras; it links Peoria-area schools, hospitals, and related industries within a 15-mile radius by a 2500-mc instructional TV (ITV) microwave network. The microwave system can be expanded to 50-mile coverage if and when needed. The 2500-mc ITV microwave band, set aside for educational use, is expected to accelerate development in all areas of ITV and educational television (ETV). Fig. 2 shows the color videotape equipment being inspected.

Dentistry

Color television for teaching dentistry has not yet become practical, according to S. A. DiSanto, D.D.S., in describing a closed-circuit TV system used for dental teaching at the School of Dentistry, University of Pennsylvania, "because, in most cases we are demonstrating procedures. Color might be useful in pathology in the study of tissue differentiation. However, color for such a demonstration must be excellent, because poor color is inferior to good monochrome with good resolution. Good color would be beyond the budget of most institutions."[1]

[1]New Techniques in Closed-Circuit Television for Dental Teaching, S.A. DiSanto, Journal of SMPTE, September 1964.

Color TV in Business

A year ago, an unusual one-shot use of color CCTV was described. The Celanese Fibers Company introduced *Fortrel*, its new Polyester fiber to 10,000 department store executives in 34 cities over the country on large-screen color projection systems.

In May 1965, RCA wil provide a color CCTV hookup for its 46th annual stockholders meeting, between the Chicago Opera House and NBC's Peacock Studio in Rockefeller Center, New York. This will be a two-way color system which will allow stockholders in New York to watch, listen, and question company officers in Chicago. Stockholders in both cities will be able to see and hear the proceedings at each location. This will be essentially a repeat of the two-way color system installed by RCA for its 1964 stockholders meetings held in Burbank, California, and New York.

Large-Screen-Projection

The General Electric "Talaria," a light-valve projector, shown in Fig. 3, displays color-television images on theater-size screens. Projection with high illumination can fill a screen of 25′ x 33′. National General Corporation plans called for use of Talaria projectors in a nationwide theater-TV network in late 1964.

The Talaria principle is based on a unique use of a layer of special

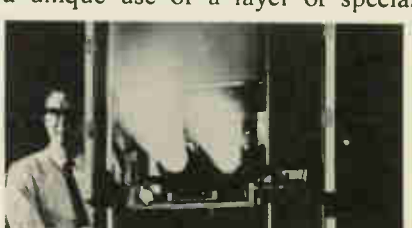


Fig. 3. Talaria projector which uses two light beams for theater-size TV.

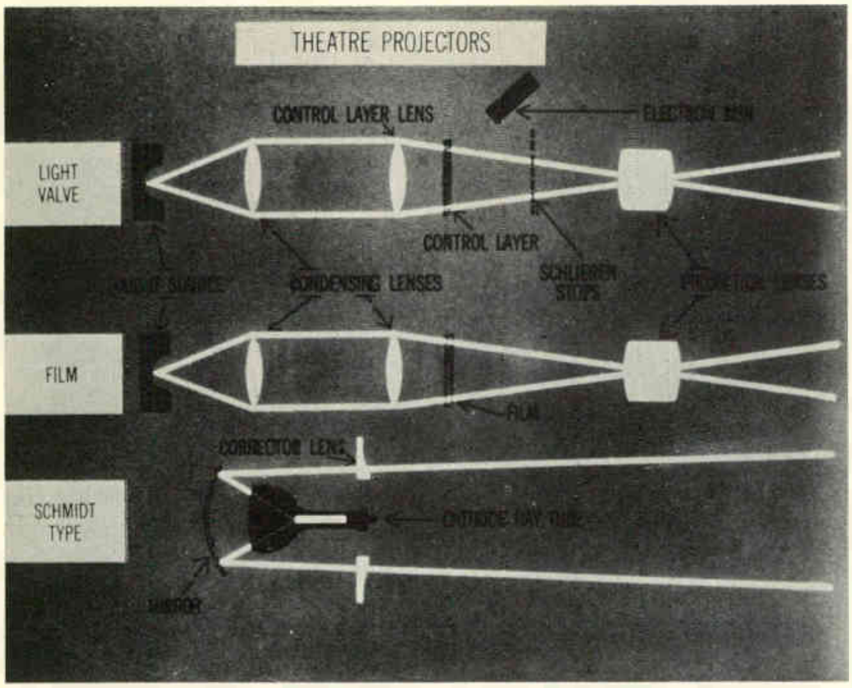


Fig. 4. Comparison of systems used for large-screen TV and motion pictures.

control fluid. The fluid, positioned where a motion-picture frame would be located in a conventional projector, is continuously scanned by an electron beam in the same manner as the phosphor on the face of a TV receiver picture tube. The scanning does not produce a picture directly on the layer of control fluid, but instead controls the instantaneous light intensity passing through the layer from a high-intensity (5-kw) xenon-arc lamp. The picture is instantaneously produced on the screen in color.

In the Talaria optical system, the total light source is intercepted by sets of stops and the screen is black as long as the layer is smooth. When a picture is to be projected, the electron beam deforms the layer surface in accordance with the picture information. Electronstatic forces which produced the deformations cause the light to be deflected around the stops and onto the screen to reproduce the original scene. Good quality color, said to be comparable to or better than color film, is thus produced in three colors from a two-beam light source.

Resolution of the Talaria system is about 500 lines, (exceeding that of home receivers) and is capable of handling the NTSC color system. It can also work on a 7-mc wideband 6.44-mc subcarrier system. The Talaria and two other projection systems are compared in Fig. 4.

Video Tape in Film Production

The movie-making industry employs color-CCTV equipment in several ways. Skelton Studios utilizes mobile color TV units to produce color video tapes instead of film for late network showing. Production editing of the tapes is done on the spot, made possible by availability of all the required equipment in the mobile units.

Another use is made of color video tape equipment by Glen-Armistead, Inc., Hollywood, the company that produces the Ernie Ford Show. Time between the end of shooting and actual network showing is sometimes 4½ hours or less, a considerable speedup as compared to filming, with more accurate and less costly results.

It is not yet possible to reproduce good NTSC color video tape recording utilizing educational-industrial grades of VTR's. However, both RCA and Ampex offer broadcast grade VTR's for color recording and reproduction. Some experiments (incomplete as of this date) by American Broadcasting Company (ABC) involve converting NTSC color video signals to SECAM (French color system) video signals for videotaping. This conversion promises the possibility of using black-and-white VTR's for color taping and playback. In the playback process, the SECAM signal is reconverted to NTSC after preamplification. This system was demonstrated at the 1965 National Association of Broadcasters (NAB) convention, March 21-25, Washington, D. C.

Home Video Tape Recorders

Of wide interest at the present moment in the CCTV video tape field is a still-confidential system developed by Marvin Camras of IIT Research Institute, Chicago, which uses ten tracks on ¼-inch tape to provide one hour of video recording on a 7″ reel at 120 ips, or two hours at 60 ips recording speed. According to Mr. Camras, the unit plugs into an ordinary TV set, and uses a total of four tubes and one transistor for video-audio

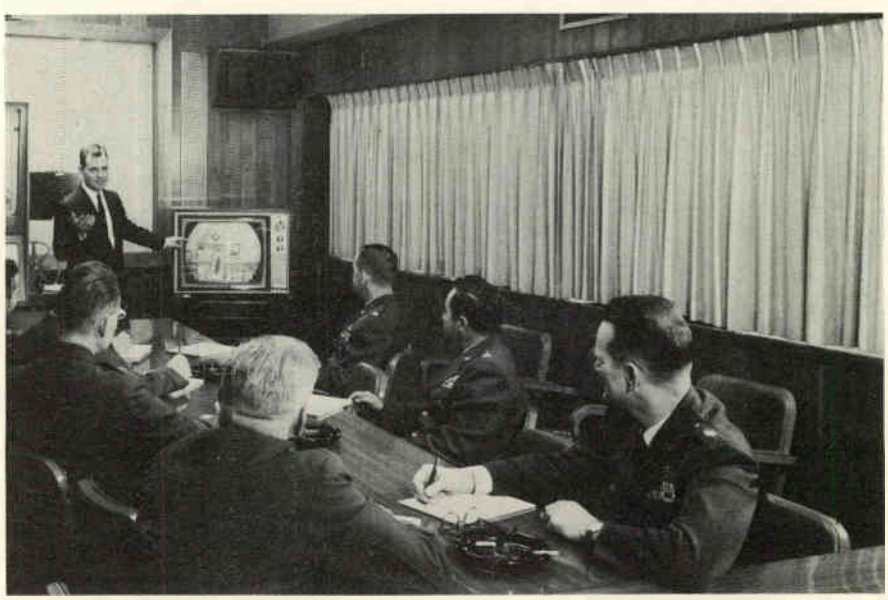


Fig. 5. Air Force Systems Command officers at a color CCTV briefing.

Fig. 6. Three-color videotape unit and color monitor used in AFSC TV system.

record and playback.

Other industry sources have speculated on capability of this recorder for color taping and playback, but this has not yet been substantiated. IITRI recently licensed a major U.S. manufacturer to produce this home video recorder, and predicted availability of the unit by 1966.

Military Applications

One of the largest color-CCTV military installations is at Air Force Systems Command, Andrews Air Force Base, Maryland. One of many uses of this RCA system (Fig. 5) is for televised briefings in color. The briefing is recorded on tape 24 hours earlier at a West Coast base. Briefing include status reports on weapons systems. Shown in Fig. 6 is an all-transistor VTR and color monitor used at one of three such AFSC installations.

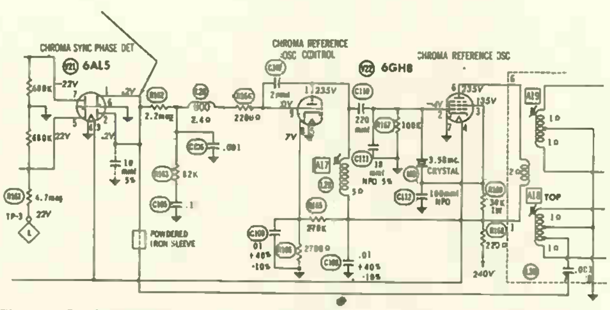
AFSC has equipped three of its bases with color TV systems, supplied by RCA, to provide staff groups with televised status reports on weapons systems. The color medium was chosen over black-and-white television for its greater impression value and flexibility on presenting complex reports in charts and other visual forms.

Future developments in color CCTV are sure to occur soon and often. There is intense worldwide interest in standardization of broadcast color TV at this moment. The systems under consideration for adoption in Europe and elsewhere include the North American NTSC system (used in the U.S.), the West Germany PAL System, and the French SECAM System. If and when standardization occurs, the benefits of lower cost, circuit simplification and development, and VTR color program exchange for broadcast and CCTV use should follow quickly. ▲

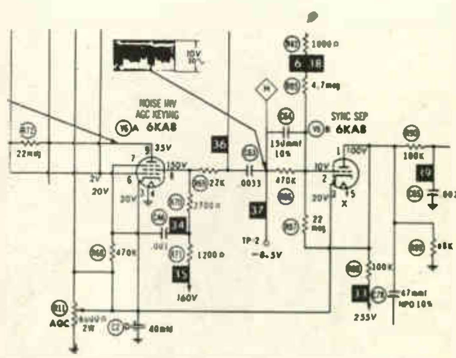
The author appreciates help given him in preparation of this article by Gil Walton, TV Systems consultant; Hal Walker, consultant and designer; Robert Vendland, Conrac; Coy L. Ludwig, National Association of Educational Broadcasters; Marvin Camras, IITRI; Edward J. Dudley, RCA; David Lachenbruck, TV Digest; Robert E. Gerson, Japan Trade Center; R. L. Harmon, Cohy Electronics; R. H. G. Mathews, Diamond Electronics; Martin Sheridan, Admiral Corporation; Harry F. Smith, Lear Siegler Inc.; Ray Benck, Medicom Inc.; D. W. Russell, GE Command Systems Division; Roy Duncan, GE Broadcast Service; Nat Marshall, General Precision Labs; Jim Boyer, Marywood College; Dr. Gene McGinnis, University of Scranton.

COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience



Chassis: Zenith 29JC20
Symptoms: Loss of color
Tip: Several other symptoms may accompany this defect: The loss of color may be intermittent; the fine tuning may be critical when receiving a color program; the horizontal hold control may also be touchy, causing changes in color hue. When symptoms of this nature appear, try replacing C107, the 2 mmf capacitor connected between the grid and plate of the 3.58 mc control tube. This capacitor has opened in a number of these chassis, causing the symptoms mentioned above. After replacing C107, it's a good idea to check and, if necessary, realign the color sync stages.



Chassis: RCA CTC12
Symptoms: Negative or severely overloaded picture.
Tip: This defect will normally give the impression of AGC trouble. After replacing the AGC keying tube, and readjusting the AGC control, you'll probably have a normal picture again. However, before you pronounce it cured, make the following test: Turn off the receiver, wait for a few moments, and then turn it on again. Wait three to four minutes to see if the trouble reappears. If the picture overloads again, you'll probably find AGC control R11 open.

small-screen color

A look inside the trend to tinyvision color.

by Stu Hoberman

Tinyvision color TV seems to be on the upswing, with manufacturers such as Toshiba, Mitsubishi, Nippon-Columbia (Niccol), Sony, and others marketing their TV products at home and abroad. So far the only manufacturer to have successfully penetrated our domestic small-screen color-TV market is Toshiba. Their 16″ set, now being sold by Sears-Roebuck under the Silvertone brand name, is the first of its kind to receive approval by Underwriter's Laboratories.

Some features of this chassis (Fig. 1), which seems to be representative of Japanese small-screen color sets, can be recognized easily as having been adapted (or adopted) from domestic large-screen color-TV sets. In most cases, the CRT's are shadowmask types, although some manufacturers are using the Chromatron or Lawrence tube. The differences between these two basic CRT types are worth noting since different circuitry is used with the two tubes.

Shadow Mask vs. Chromatron

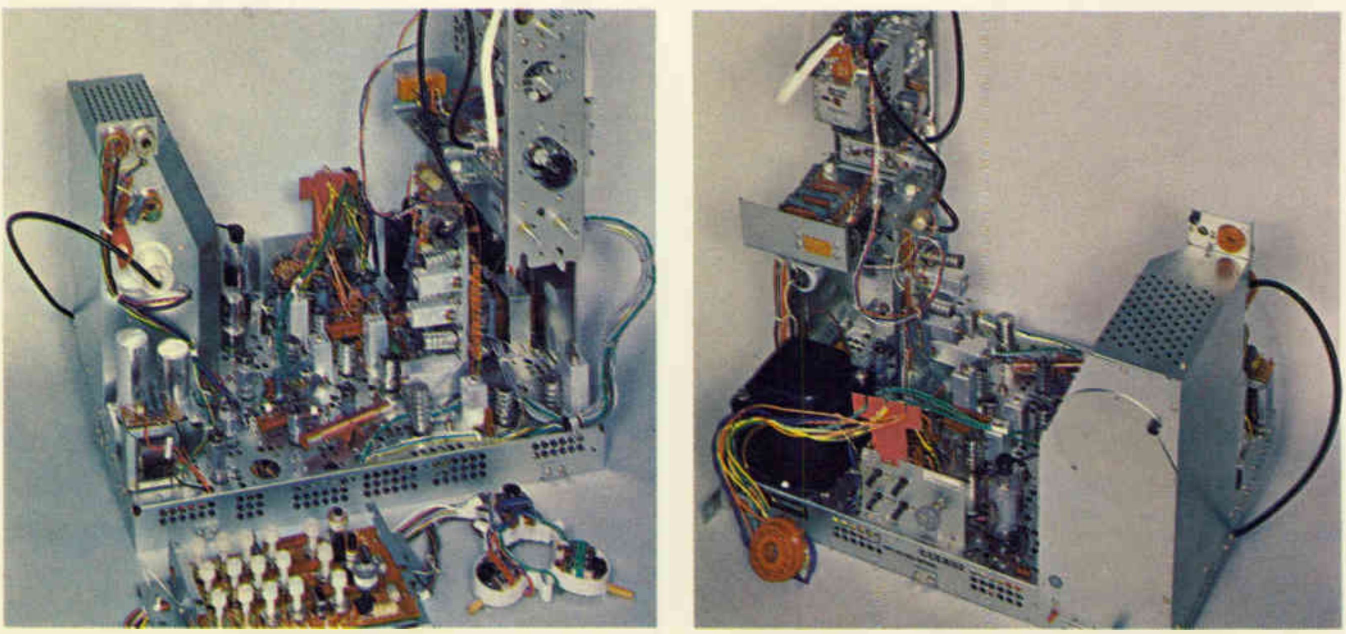
Basic features of the shadow-mask tube include the three guns, three-color (dot) phosphor screen, shadow-mask plate, plus the need for a convergence circuit and coils. The Chromatron system (Fig. 2) uses a single gun, specially designed color grids to eliminate parallax and control the direction of the electron beam(s) emitted from the gun, and a three-color phosphor-striped screen. The electron beams can be concentrated on any portion of the screen. The CRT high voltage is applied between the color grids and the phosphor screen in order to form an electrostatic lens which properly focuses the electron beam before it hits the screen. This post-deflection focus, in combination with the use of high acceleration potentials, results in greater image brightness than is obtainable in the conventional shadow-mask types.

The electronic lens in the shadow mask is formed by apertures in the shadow-mask plate. For this reason, precise alignment of the electron beams from each gun is a must; if the beams do not pass through the aperture evenly, convergence problems arise. In the chromatron tube, the electrostatic lens formed by the color grids gathers a greater portion of the beam and provides sharper definition (see Fig. 3). The openings between the grids can be 5 to 6 times greater than the apertures in the shadow-mask type tube.

The trinescope, another display system, was developed by RCA in 1949 to demonstrate the feasibility of color TV to the FCC. In this system, three separate single-gun CRT's are used, one for each color. The color image is a composite display created by focussing the three images on a single viewing surface by optical means.

Automatic Control Circuits

Much of the automatic control circuitry that you can expect to see in Chromatron sets will be familiar. One feature worth mentioning is



(A) Front view

(B) Rear view

Fig. 1. This Toshiba color-TV chassis is typical of those presently imported into the U.S.

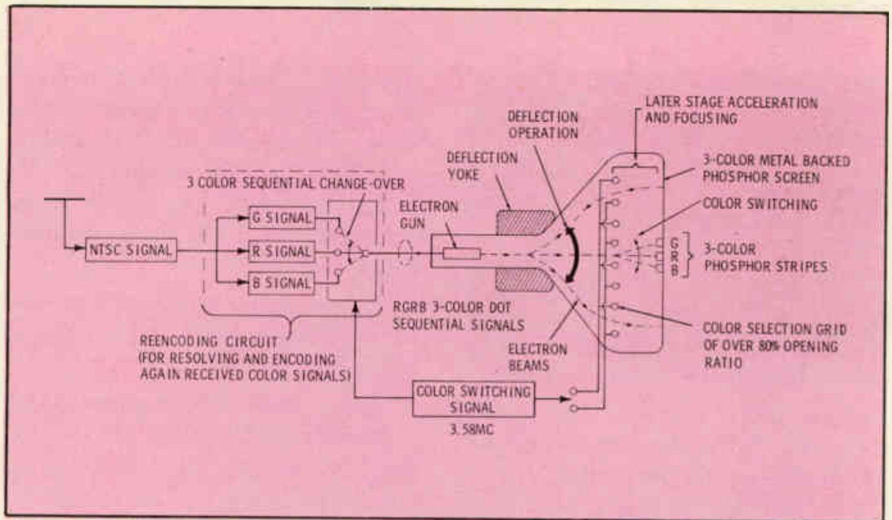


Fig. 2. Basic Chromatron color system uses single-gun, special color grids.

automatic - phase - control circuitry, sometimes called APC or AFPC. A partial schematic diagram of the APC circuits used in the Toshiba set is shown in Fig. 4.

The function of this control system is to enable the local 3.58-mc oscillator to stay in exact phase with the 3.58-mc signal from the source of the color program. As the color program is transmitted, a sample of the 3.58-mc signal is supplied (during the horizontal blanking period) to the receiver by means of a short *burst* consisting of approximately 8 cycles from the station's own 3.58-mc generator. The control circuit uses this color-burst signal to synchronize the local 3.58-mc oscillator with the transmitter signal.

A closed loop is formed by the phase detector, the 3.58-mc oscillator, and the reactance tube. In the phase detector, the incoming burst signal is compared in frequency and phase with the local 3.58-mc oscillator signal. When both signals agree, zero voltage is applied to the control-tube grid circuit. If the phase of the incoming burst signal is not in agreement with the local oscillator, a correction voltage is applied to the control-tube grid. The polarity and magnitude of the correction voltage developed in this manner are dependent on the direction and amount of departure from zero phase of the 3.58-mc oscillator signal; the positive- or negative-going correction voltage tends to bring the local oscillator into sync with the burst signal.

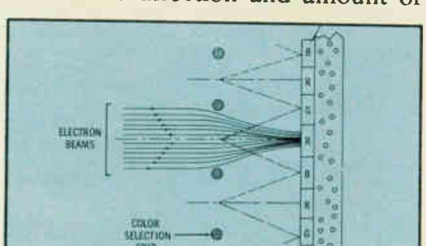


Fig. 3. The Chromatron uses post-deflection grids instead of shadow mask.

Color Demodulation

To obtain a color picture which accurately reproduces the colors being televised, the color demodulators must perform unerringly. In the Toshiba chassis several adjustments are required to insure correct demodulation. The signal supplied from the secondary of the burst transformer (T503—Fig. 4) is the color sync signal. The phase of this signal is controlled by the core setting and to a limited extent by the setting of the *tint* control, which is part of a phase-shifting circuit. The control circuitry and color sequence zero in on this signal. The adjustment of the burst transformer provides coarse control of the reference-signal phase, and the tint control provides fine variations.

Another adjustment relating to demodulation is the 3.58-mc oscillator transformer whose primary tunes the plate circuit. The secondary of the burst transformer supplies a sampling signal which is compared with the burst signal in the phase detector and applies the CW signal to the demodulators through a phase-shifting and isolation network. Each demodulator receives a separately phased 3.58-mc signal, with the amount of phase shift controlled by this network.

In the Toshiba/Sears chassis, the various adjustments are easily checked. The reactance coil coarsely sets the operating frequency of the 3.58-mc oscillator. A test point is made accessible for the purpose of grounding the correction voltage; the reactance coil is then adjusted until a slowly drifting or stationary color pattern is obtained. When the ground connection is removed, the pattern should remain stationary.

Since the burst transformer supplied the reference signal for the control system, it is adjusted for maximum response to the 3.58-mc burst signal and for proper display of color bars with the hue control at midrange.

Three-Step Field Adjustment

A simple three-step procedure for adjusting the 3.58-mc circuits in the field, using only a VTVM and color-bar generator, is:

1. Connect the color-bar generator to the receiver and set it for a low-level color-bar pattern. Connect VTVM to pin 1 of V122A. Set tine control to midrange.
2. Ground the correction voltage at test point TP104 and adjust reactance coil L503 for a stationary bar pattern (zero beat).
3. Adjust the primary of the 3.58-mc oscillator transformer (T504) and burst - phase transformer T503 for maximum indication on the VTVM.

On the basis of the bar pattern displayed on the CRT, a final touchup may be made by a slight readjustment of T503.

Accessibility of Service Adjustments

In domestic color-TV sets, the adjustments used most often are easily accessible at the rear of the chassis

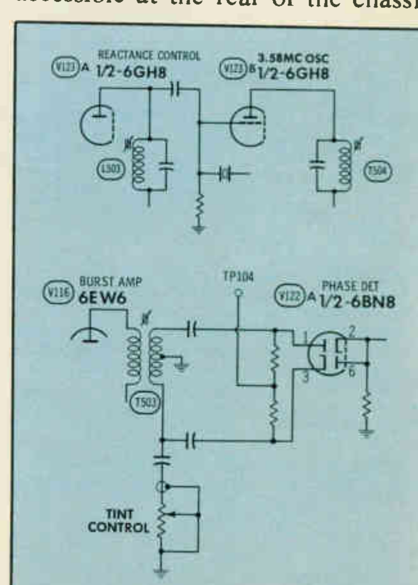


Fig. 4. Color subcarrier adjustments for the Sears-Roebuck 16-inch color TV.

(see Fig. 1B). With the possible exception of screen switch S102, this also applies to the Toshiba set.

Screen switch S102 is provided for the separate inspection of red-, green-, and blue-field purity without upsetting the CRT adjustments. To check red-field purity (for example), set switch S102 to R position. A red spot in the center of the screen is an indication that the red-field purity magnet is set properly, but that the deflection yoke has shifted. Repositioning the yoke is probably all that is needed to obtain field purity. If the impurity is in the center area of the screen, correction should be made by adjusting the purity magnet on the neck of the CRT (see Fig. 5). After purity is obtained, set the screen switch to the W position and reset the static convergence, if necessary.

What to Expect

The number of color sets sold in Japan from 1960, when color broadcasting began, to the end of 1963 is estimated at about 16,000.

Fig. 5. Convergence setup being made.

During 1963, relatively low-priced 14″ and 16″ color sets were introduced, which accounted for a 50% increase in sales over the previous year. Sales during 1964 were estimated at about 20,000 sets. As the total output increases, we can expect to see more and more of the small-screen color sets in TV shops. Here are some notes on sets you might see in the future:

Fuji Electric Co., Ltd., — A 16″ consolette color TV, Model TF6-CS10. Some features of this set include: a 20-watt dual speaker system, matrix circuit to emphasize natural coloring, and a shadow-mask CRT with a high-intensity fluorescent plate. Tube complement is 27 tubes, plus the CRT. Cabinet dimensions: 32 in. wide, 23¼ in. deep, and 20½ in. high; weight, 88¼ lb.

Yaou Electric—A new 9″ transistorized color TV using colornetron system.

Nippon-Columbia (Niccol) — An 11″ shadow-mask type, Model 11CK-7.

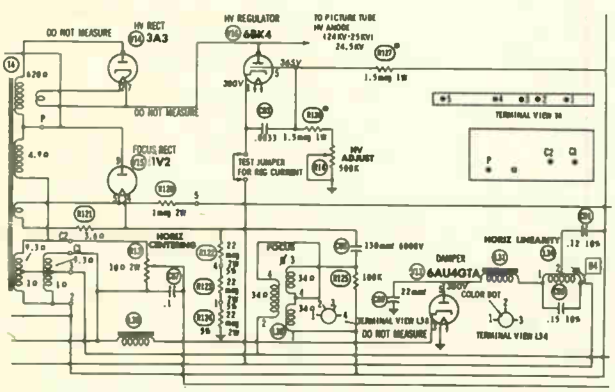
Sony—A 19″ Chromatron model.

Mitsubishi Electric Corp.—A 6″ Colot-6, Model 6CT-323, trinescope-type.

It appears that the slow acceptance of Japanese small-screen color may be due not only to FCC regulations that all incoming sets be equipped with UHF provisions, but also to low volume, high pricing, and the misconception that the black-and-white sets now occupying the second-set market can be replaced by small-screen color. However, these problems are not insurmountable, so get your color gear and magnifying glasses ready—here comes small-screen color! ▲

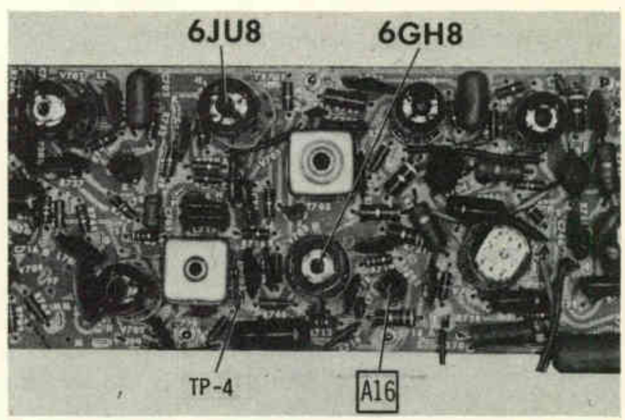
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

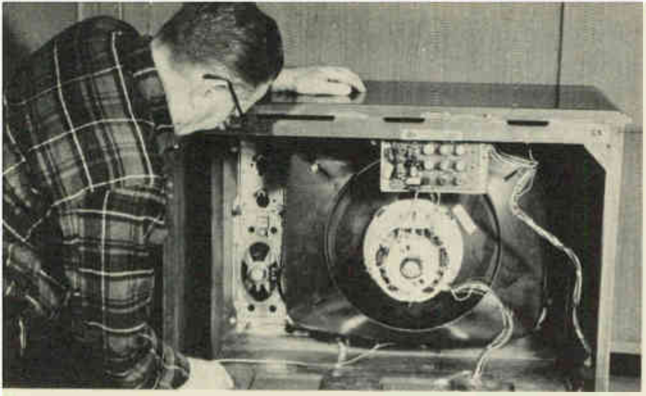


Chassis: Admiral 25E6
Symptoms: Loss of focus with severe blooming on the CRT.
Tip: Several causes of this defect were covered in the December, 1962 issue—and here is another. C93, the .0033 mfd capacitor connected from the cathode to the grid of the 6BK4 regulator tube, develops high-resistance leakage, upsetting the regulator circuit. When this occurs, the high voltage is reduced, producing a blooming raster with a loss of focus. Don't forget to make this component one of your prime suspects when these symptoms are present.

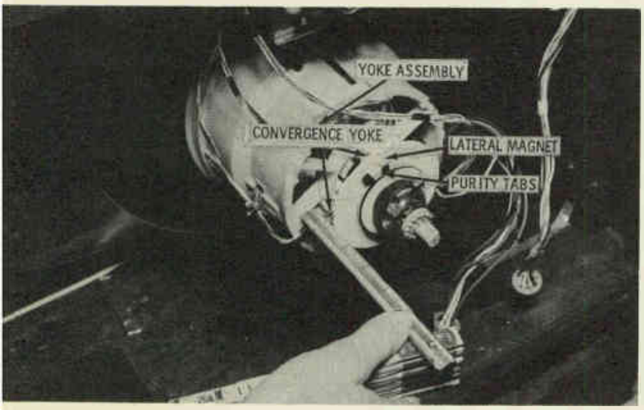
In some receivers, you may find the leads of C93 are carefully spaced by a piece of fish paper. Don't discard the paper when replacing the capacitor. Redress the leads of the new component in the same manner as the original; the leads serve as a spark gap for the regulator circuit.



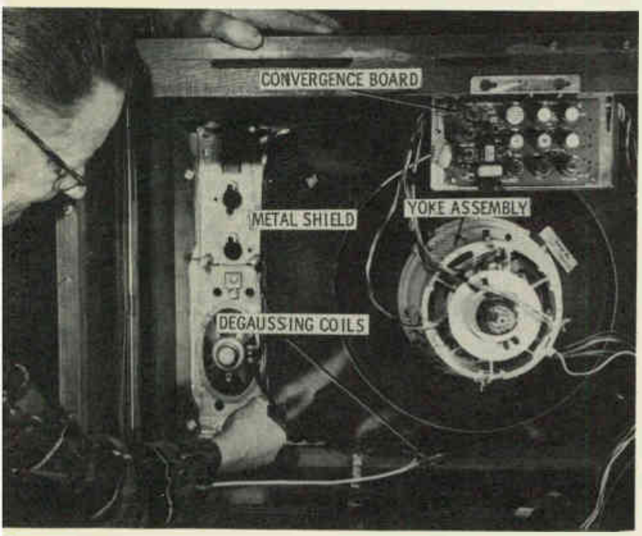
Chassis: RCA CTC12
Symptoms: Loss of color sync, indicated by three blobs of color running across screen; predominant color will usually be red.
Tip: This defect normally occurs about six months after a receiver has been installed. First, try replacing the 6GH8 chroma oscillator and control tube, and the 6JU8 chroma sync phase detector-killer detector. Check to see if operation returns to normal, using a color signal from a station if possible. (The signal from your color-bar generator may be strong enough to force the colors into sync.) If you must use a generator, don't connect the output leads directly to the set, but merely lay them close to the receiver's antenna. If the out-of-sync condition remains after the tubes have been replaced, you'll need to retune the chroma reference oscillator coil in the following manner: ground TP-4 on the chroma printed-circuit board (to remove AFC voltage), and adjust A16 for a zero beat of the color-bar pattern (color bars stopped, or floating slowly across the screen). As a final step, check operation of the tint control for its normal range—flesh tones varying from green to magenta.



1. Initial preparation consists of taking the chassis from the cabinet, unhooking all cables, and preparing to remove the purity tab, lateral magnet, and the convergence and deflection-yoke assembly. As a safety precaution, wear safety glasses and do not allow other persons to work or watch within range of possible flying glass.



2. In case you are not familiar with the location of these components, measure their position by using a rule or other suitable tool. This procedure may prove helpful, especially if you record them for future reference. Be sure that the tube is completely discharged. Note that the yoke assembly also contains the convergence coils and fits tightly against the tube.



3. A metal flange surrounds the tube bell, near the face, and the automatic degaussing coils (ADG) are fastened to this framework. It will be necessary to loosen the four 5/16" bolts located on the metal front. These bolts hold the flange and must be removed in order to gain access to the CRT mounting bolts. Drop down the convergence assembly. Remove the purity tab, lateral magnet, and yoke assembly from the neck of the tube.

4. Spread a heavy pad or blanket on the floor to prevent scratching the cabinet. Use two men to lay the cabinet down on the pad. Now be especially careful not to rap the CRT with a tool or other heavy object. The CRT must be handled with care, since it can implode and cause serious damage to you and the set. Remove the four 5/16" bolts that hold the tube in place. Be sure they don't get lost.

How to Replace Rectangular Color CRT's

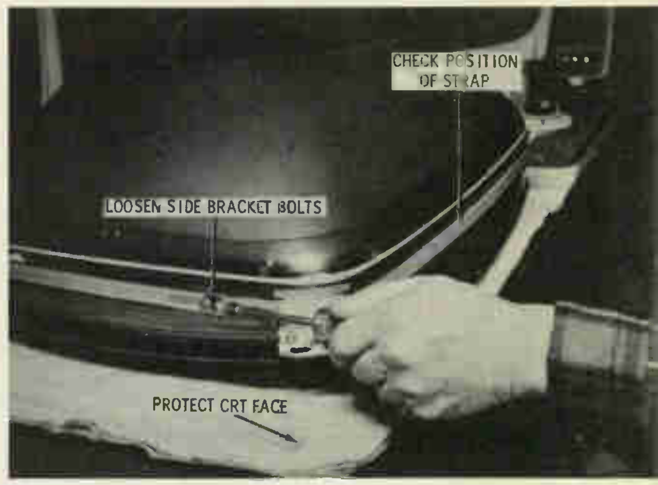
by Homer L. Davidson

Here is a logical, step-by-step replacement procedure for removing and installing a typical 25" color picture tube. The photo sequence provides tips and instructions for a simple, "one-shot" replacement, along with safety precautions and time-saving hints.

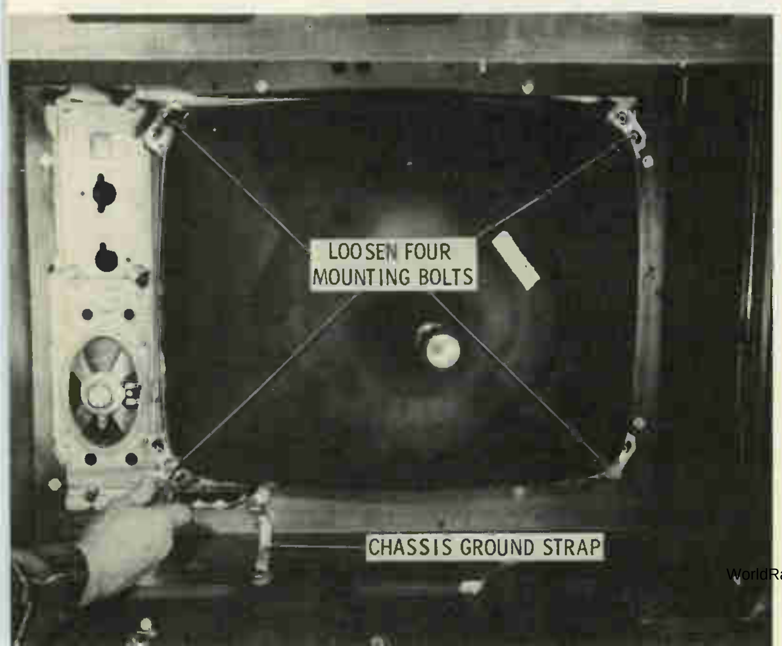
8. Position a degaussing coil near the picture tube to completely neutralize any induced magnetism. This step will help to insure proper purity and convergence when the picture-tube circuit is actuated. Hook up the dot-bar generator. Make purity and convergence adjustments. Give the set a thorough operational check.

7. Fasten the convergence board in place, install the chassis, and connect all cables. Make certain that all parts are replaced and tightened. Banging against metal parts will sometimes induce magnetism into those parts and a second degaussing will probably be required.

6. Check the location of the metal band on the base of the CRT, loosen the side bracket bolts, and remove the bracket from the tube. Mount the bracket to the new tube, using the same bracket bolts. Seat the tube in place, being sure that the blue gun is positioned at the top of the set; the high-voltage button will then be at the top of the cabinet. Now tighten the bracket bolts, and replace the metal shield and degaussing-coil assembly. Replace the yoke assembly, and turn the set upright on the floor again.



5. Lift the tube gently, tilting the tube when necessary, and carefully set the CRT on the edge of the cabinet. Get a better grip on the two corner flanges, and then set the tube on the service bench. Be sure to have a protective cloth or paper underneath the CRT. Do not pick up or carry the tube by the neck, since this is the weakest part of the tube.

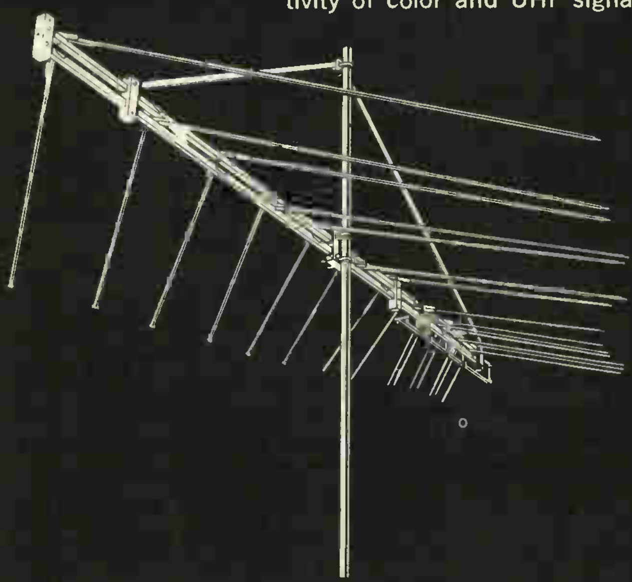


ZENITH

The quality goes in before the name goes on

FOR THE FINEST COLOR AND UHF RECEPTION INSTALL ZENITH QUALITY ANTENNAS

. . . to assure finer performance in difficult reception areas! More color TV sets and new UHF stations mean new antenna installation jobs for you. Proper installation with antennas of Zenith quality is *most* important because of the sensitivity of color and UHF signals.



ZENITH ALL-CHANNEL VHF/UHF/FM AND FM-STEREO LOG-PERIODIC ANTENNAS

The unusually broad bandwidth of the new Zenith VHF/UHF/FM and FM-Stereo log-periodic resonant V-dipole arrays pulls in all frequencies from 50 to 900 mc—television channels 2 to 83 plus FM radio. The multi-mode operation provides high gain and good rejection of ghosts.

These frequency independent antennas, developed by the research laboratories at the University of Illinois, are designed according to a geometrically derived logarithmic-periodic formula used in satellite telemetry

ZENITH QUALITY HEAVY-DUTY ANTENNA ROTORS

Zenith quality antenna rotors are heavy-duty throughout—with rugged motor and die-cast aluminum housing. Turns a 150-lb. antenna 360 degrees in 45 seconds. The weatherproof bell casting protects the unit from the elements. Each rotor mounts easily to either a mast or tower without an adapter.

ZENITH QUALITY WIRE AND CABLE

Zenith features a full line of quality packaged wire and cable. Also especially designed UHF transmission wires, sold only by Zenith. Zenith wire and cable is engineered for greater reception and longer life, and is available in various lengths to suit every serviceman's needs.

Check the Yellow Pages for the Zenith Distributor nearest you.
Or write to Zenith Sales Corporation, Parts and Accessories Division,
5801 West Dickens Avenue, Chicago, Illinois 60639,
for Distributor name plus complete catalogue and technical
information on Zenith Quality antenna installations.

Specifications subject to change without notice.

Chroma Circuits in Zenith Sets

An up-to-date report on how color stages function.

by Jack Clouse

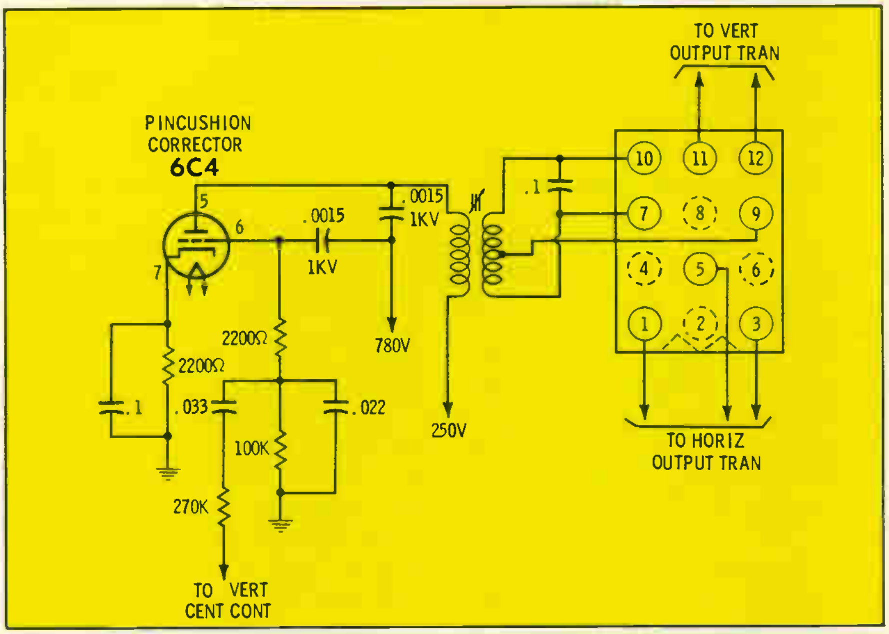


Fig. 1. Pincushion-corrector circuit from latest model of 25" Zenith color set.

Zenith introduced three chassis into their 1965-½ color line in order to make merchandising a little more versatile. The model numbers of these chassis are: 25MC33, 25-MC36, and 24MC32.

The 25MC33 is the carryover chassis with stepup features such as Peak-Picture control, ADG, Color-Off switch, and the fin-cooled power transformer. The color circuitry, however, remains almost identical to the 25MC30 and 25LC30.

With the introduction soon of the 25" rectangular-tube receivers into the line, Zenith's 25MC36 chassis has circuitry very similar to the 25-MC33 except for the addition of a pincushion corrector circuit (Fig. 1) for adjusting the top and bottom of the raster so that it is symmetrical with the picture-tube mask. The layout of this chassis has been rearranged so that physically it has a new look.

The 24MC32 chassis is a stripped-down version having characteristics similar to the 25MC33 and the 25-MC36. Features such as video peaking, ADG, Color-Off, and the fin-cooled power transformer have been removed in order to simplify the design. This new chassis has the outward appearance, without some of the refinements, of the 25MC36 which is used in the 25" models only. However, the 24MC32 introduces a color-sync section that is slightly revised compared to previous Zenith color circuits.

Chrominance Amplifiers

The color signal is coupled from the video detector through a 7-pf capacitor (Fig. 2) to the first chroma-bandpass amplifier (6KT8). After amplification, this signal is applied to the second chroma-bandpass amplifier (6JC6) through a 220-pf capacitor and to the burst amplifier (6JC6) through a 47-pf capacitor.

Connected to the input of the second chroma-bandpass amplifier is the color-killer circuit. The color-killer control is part of a voltage divider network which adjusts the point of conduction of the second chroma-bandpass amplifier; it is preset at the factory and need not be readjusted unless difficulty is encountered in receiving a weak color signal.

The 50-volt negative killer voltage is taken from the grid of the horizontal discharge tube (Fig. 3), and is applied to the grid of the second chroma-bandpass amplifier through the 330K resistor and the color-level control (Fig. 2). This voltage keeps the second chroma-bandpass amplifier turned off except during color reception.

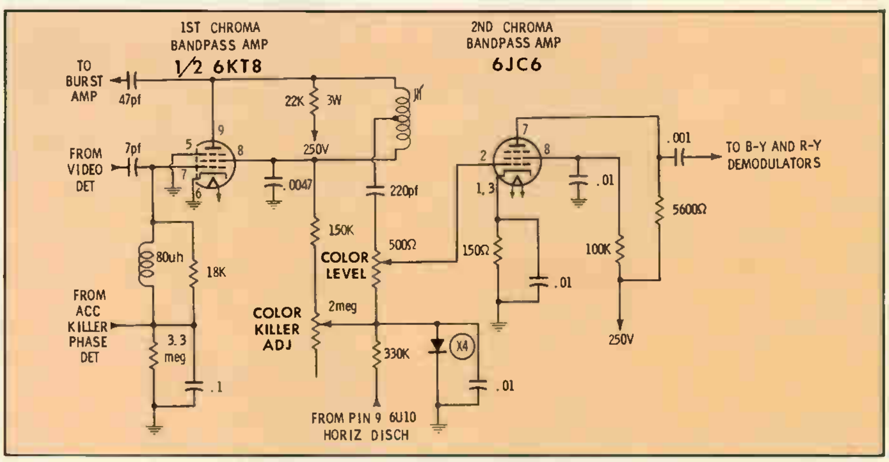


Fig. 2. A new chroma-bandpass circuit for the 24MC32.

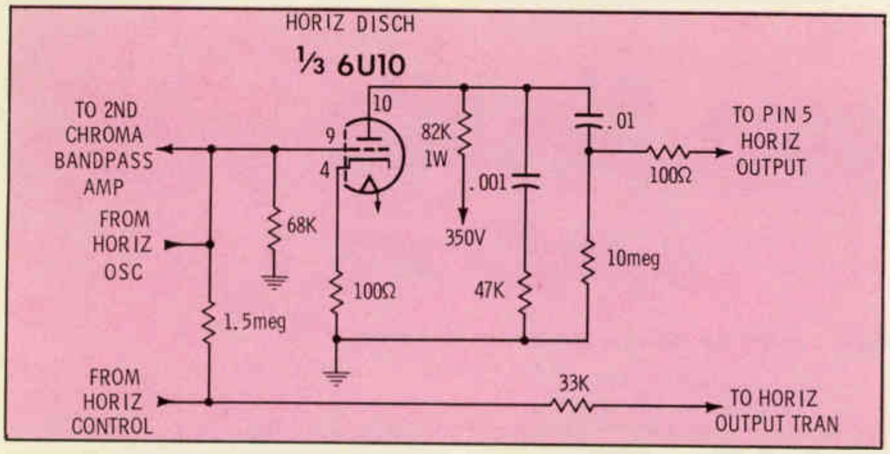


Fig. 3. Horizontal discharge circuit is source of voltage for color-killer.

Diode X4 (Fig. 2) acts as a clamp and keeps the second chroma-bandpass amplifier grid from going positive and possibly drawing grid current.

After amplification in the second chroma-bandpass amplifier the color information is applied to the B-Y and R-Y demodulators.

Burst Amplifier

As shown in Fig. 4, a type 6JC6 tube is used as the burst amplifier, replacing the 6EW6 used in other chassis for burst separation.

The burst amplifier is triggered by a timed pulse from the horizontal convergence circuit allowing the tube to conduct only during the time the few cycles of burst are present. The burst signal is thus separated and amplified and appears in a resonant tank circuit tuned to 3.58 mc.

ACC Killer Phase Det.

Regardless of the phase of the burst signal applied to the ACC dual diode, one diode always conducts more than the other in such fashion as to develop a negative voltage at the junction of resistors R1 and R2. When no burst is applied, the voltage at this terminal is almost negligible. The voltage at this point may vary from zero to −12 or −14 volts depending on the strength of the burst signal. Since this is a fluctuating voltage dependent on burst signal strength, it is used for two purposes: First, it is the source of automatic-color-control (ACC) voltage that is applied to the grid of the first chroma-bandpass amplifier. The higher the burst signal, the higher the ACC voltage and the lower the gain of the tube. Second, it is used as a cutoff voltage to disable the color-killer stage which is used to cut off the second chroma-bandpass amplifier during black-and-white reception.

During black-and-white reception, there is approximately 110 volts on the screen grid of the first chroma-bandpass amplifier with negligible corresponding voltage applied to the grid. With the presence of color, ACC voltage is developed and applied to the grid of the first chroma-bandpass amplifier causing an increase in screen voltage. This increase, when applied to the second chroma-bandpass amplifier grid through the color-killer adjustment, nullifies the −50-volt killer voltage, thus opening the bandpass amplifier for color reception.

Chroma Sync

The 3.58-mc burst voltage appearing across the phase detector transformer is used as a reference phase for the color signal sync circuits. The hue control is used to shift the phase of the incoming burst signal so that the 3.58-mc CW oscillator signal being fed to the demodulator tubes for detection is aligned exactly with respect to the two color signals coming in from the output of the chrominance amplifier. With an accurately balanced injection transformer adjusted for 90° phase difference the demodulators will reproduce correct color signals for the picture-tube grids.

The shifting of the burst phase by the hue-control adjustment varies the 3.58-mc CW reference signals being applied to the 6JH8 demodulators through the secondary windings of T20. Any slight change in frequency by the 3.58-mc oscillator is immediately registered in the ACC killer phase detector and the chroma sync phase detector by the feedback windings from the phase detector transformer secondaries. Any deviation from frequency will cause a correction voltage to appear at the grid of the chroma reference oscillator control tube (6KT8), which will bring the system back on frequency. ▲

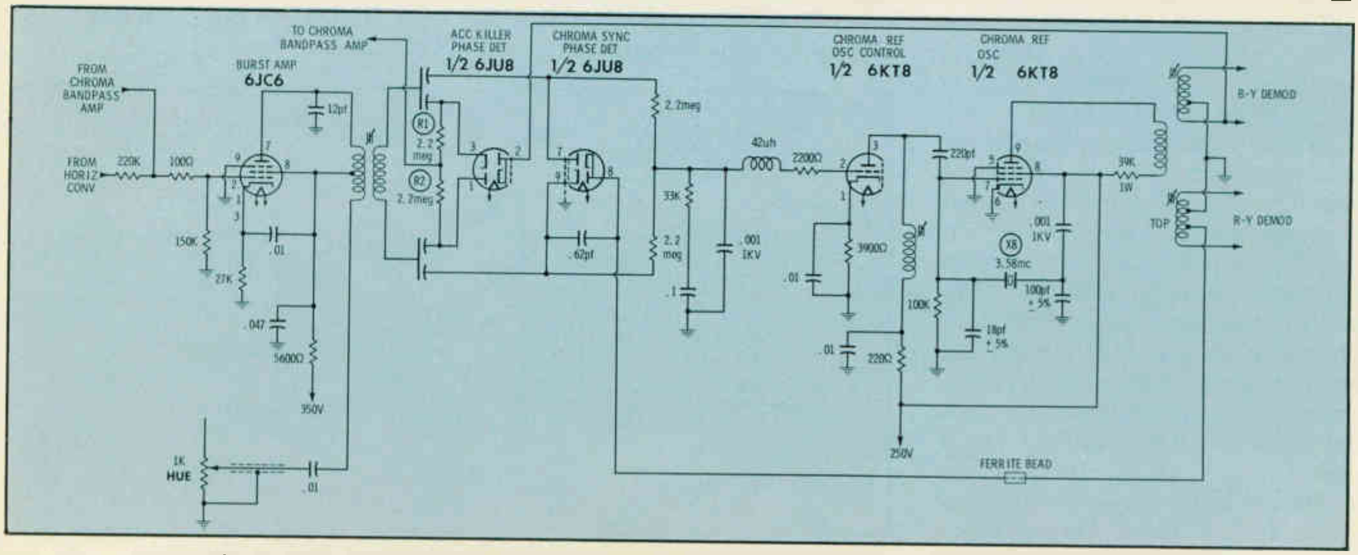
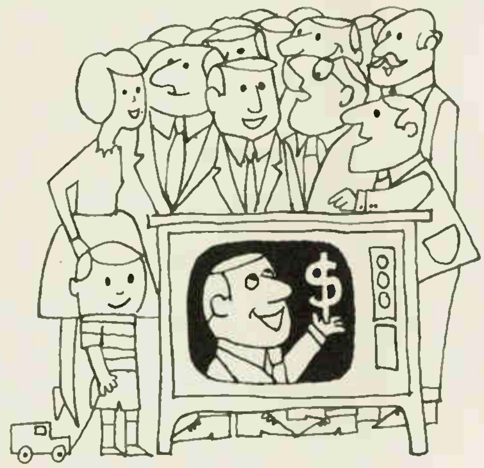


Fig. 4. New burst amplifier, ACC killer phase detector, and color sync for the 24MC32.

Since 66 out of 100 consumers picked Sylvania's new color bright 85™ picture tube as brightest, clearest, best...

shouldn't you be in the picture?



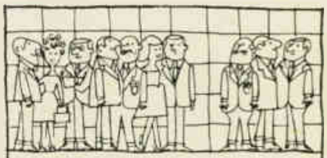
More sales profit, more service profit are yours with the *color bright 85* picture tube. Because it offers something better, consumers prefer it. They expect to pay a little more to get the best.

In all six major cities recently surveyed, consumers told us they like the *color bright 85* tube best in an independent side-by-side test with three other leading brands.

Here's proof that you should be in the profit picture:

	BRIGHTEST COLOR PICTURE	BEST OVERALL COLOR PERFORMANCE	CLEAREST COLOR PICTURE TO WATCH	BRIGHTEST BLACK AND WHITE PICTURES
Sylvania **color bright 85** picture tube	76.1%	66.6%	68.0%	77.7%
Picture Tube A	6.9	9.8	8.9	7.4
Picture Tube B	9.5	13.7	13.4	7.1
Picture Tube C	7.5	9.9	9.7	7.8

Test made under supervision of John J. Henderson and Associates, N. Y. Note: Not all people answered all questions—votes tabulated for 100% of answers to each.



Sell the
color bright 85
picture tube...
voted brightest by
7 out of 10 consumers.

A lot of people saw the difference. So can you. In the product. In your profits. Sylvania Electronic Tube Division, Electronic Components Group, Seneca Falls, New York 13148.

SYLVANIA

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS GT&E

Chroma Demodulators in Motorola Sets

An up-to-date report on how color stages function.

by Don Lowry

During 1964, color television became a billion-dollar business for the industry. With this many dollars involved, it is a fair guess that there will be considerable effort directed toward finding simpler and better ways of providing the necessary circuit functions in color TV. One example is the new system of color demodulation developed by Motorola for use in the TS-916 chassis (Fig. 1).

Basically, the new demodulator is a self-oscillating high-level demodulator. Therefore it is capable of reinserting the chroma subcarrier and producing in excess of 200 peak-to-peak volts of chroma drive for feeding the color CRT directly. Via this arrangement, the two demodulators normally used permit the three-color-difference amplifiers, the 3.58-mc oscillator, and the reactance-tube functions all to be combined in a single tube.

In most television receivers today, in order to produce the required color-difference signals for driving the CRT, the instantaneous phase of the transmitted chroma signal is compared to both phases of a local oscillator signal. In the Motorola system, the chroma signal is split into two opposite phases and is compared to the 3.58-mc oscillator signal. In either case, the same color-difference signals are produced.

The output of the color-IF system, after passing through the two phase-shift networks, applies the chroma signal, approximately in quadrature, to the two G3's (grid 3) in the 6LE8 tube. A sample of the station color signal is also taken from the color-IF amplifier and fed to the color-sync amplifier and to the gate circuitry where the color sync is separated from the rest of the chroma signal and then amplified. The amplified sync then passes through the crystal filter to G1 of the 6LE8 and locks the 3.58-mc oscillator into correct phase relationship with the station's color sync.

3.58-mc Oscillator Operation

In order to simplify understanding the operation of the demodulator system, let us first consider only the 3.58-mc oscillator section. This section is shown in simplified schematic form in Fig. 2.

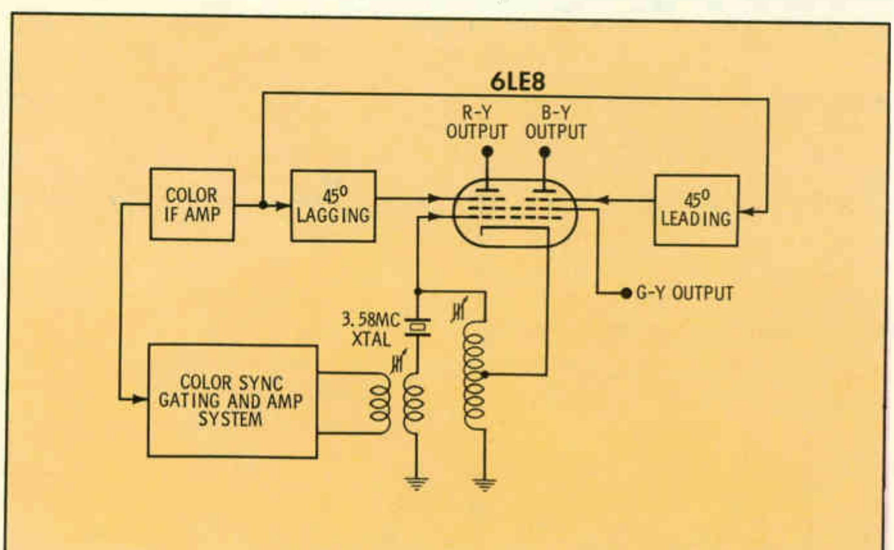


Fig. 1. Color section of the TS-916, showing new chroma demodulation circuits.

If we were to ground point A, we would have a fairly conventional crystal-oscillator circuit, with G2 acting as the plate element. Feedback to sustain oscillation is provided by tapped cathode coil L1.

The oscillator signal is needed only for switching the demodulator tube off and on at a 3.58-mc rate; this signal must be removed from the output in order to avoid having it seen in the picture. Removal is accomplished by the trap circuit consisting of C1, C2, C3, and L2. This unusual circuit provides this series trapping action for both plates and G2 with a single coil (L2).

The 3.58-mc crystal is not connected to ground directly, but through an impedance (secondary of T1). This series impedance slightly lowers the Q of the crystal so that its frequency can be controlled by the color-sync signal. The transformer also provides a convenient means of injecting the station locking signal and adjusting the injection strength. The net reactance in the secondary of T1 is always capacitive; if its capacitive effect is increased by tuning T1, the oscillator strength is reduced. As the capacitive reactance is made smaller, the oscillator signal strength is increased. The tuning of T1 will affect the oscillator frequency slightly, and this is compensated for by readjustment of L1. T1 is first adjusted to provide the proper oscillator strength, and L1 is then adjusted to place the oscillator on the required frequency.

Since the color-sync signal thus must pass through the high-Q 3.58-mc crystal, excellent noise immunity characteristics are obtained. The Q of this circuit also causes the bursts to ring the crystal, providing a continuous signal to G1 between each burst of signal. If we were to stop the oscillator and connect an oscilloscope, we could see the waveforms shown in Fig. 2. Notice that the bursts of color sync produce a continuous signal after passing through the crystal.

Color Demodulator Section

In order to understand how the demodulator produces color-difference signals suitable for driving the CRT, it is convenient to resort to the use of vectors. Fig. 3 is a simplified schematic equivalent of the demodulator, minus the oscillator section, with the significant vectors drawn below. The complete chroma signal is coupled to the two phase-shift networks C1-R3 and C2-R4. These two networks divide the signal into two signals displaced equally in phase by approximately 90°. The first network (C1 and R3) causes the applied signal to lead by 45° and applies it to G3 in the B-Y section.

Depending on the respective phase, these signals at the G3's will either add to or subtract from the oscillator injection, causing a change in the average plate and G2 current. These current changes produce a proportional voltage change across the resistive load elements and provide voltage drive for the CRT grids.

The phase vectors as they appear in various parts of the circuit for a transmitted red signal are shown in Fig. 3. At point B, the complete signal is together and has its transmitted phase. Red is at 103°; the color sync is at 180°, as shown. At this point the color sync is removed, and, after passing through the color-sync amplifier and the gate circuitry, it arrives at the oscillator grid (G1) with a phase of 270°. The red signal locks the local oscillator in phase with the color sync, so that the local oscillator always operates at 270° and serves as reference phase for all colors.

The chroma signal passes through the chroma control, an additional amplifier stage, transformer T2, and arrives at point C with all signals leading their transmitted phase by 45°. For a red signal this is 148° (103° + 45°). This 148° signal passes through the C1-R3 phase-shift network, causing the signal to lag by 45° and arrive at the red G3

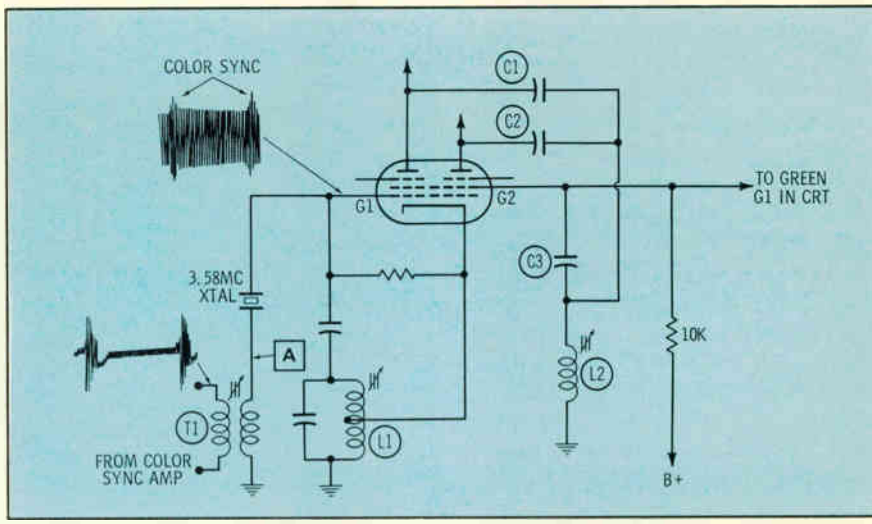


Fig. 2. Simplified schematic of 3.58-mc oscillator is aid to demodulator know-how.

with its original phase of 103° (148° − 45°).

On the blue G3 the chroma signal is approaching an in-phase condition with the 270° oscillator signal and causes an increase in the average plate current. The increased plate current drops the demodulator plate voltage, which in turn lowers the blue G1 voltage in the CRT and turns the blue gun off.

We have now shown how the transmitted red signal turned the green gun on and the blue gun off. An "off" or negative-going signal is also required for the green gun to cancel the brightness signal in the Y channel. A negative signal is produced at G2's and is present for all colors. The action can best be described if we consider a transmitted green signal.

The transmitted phase for green is 241° at point B in the circuit. By the time it reaches point C it has been shifted in phase to 286°. The green signal then passes through the two phase-shift networks and is 241° arriving at the red grid and 331° at the blue grid. Notice that both of these signals are approaching an in-phase condition with the 270° oscillator signal, which will effectively increase the oscillator in-

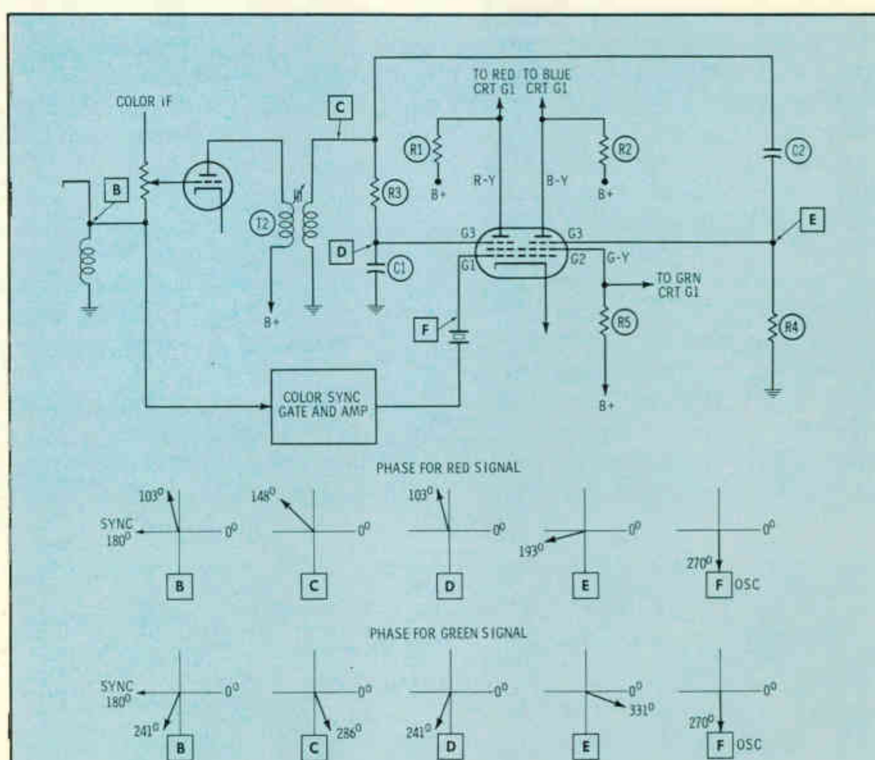


Fig. 3. Schematic equivalent of the demodulator, less 3.58-mc oscillator section.

jection and also increase the plate current to both the red and blue sections of the tube. The increased plate current reduces the voltage on the blue and red guns in the CRT, thereby turning them off.

The increased current to both plates means there is an increased attraction for electrons. This increased attraction accelerates the velocity of the electrons as they pass through the demodulator G2 so that fewer electrons are collected on this grid. The reduction in G2 current causes the voltage to rise and turns the green gun on.

Adjusting and Servicing

Since the functions of the usual three color-difference amplifiers, the two demodulators, the 3.58-mc oscillator, and the reactance stage are combined in a single tube, the servicing and adjustment procedures are somewhat simplified. As a matter of fact, there are only three tubes in the color circuits of this receiver. These stages provide all the necessary functions, with ample reserves for tube aging and safety factors.

The color-IF system in the TS-916 is aligned by using sweep equipment in the usual manner. The color-sync amplifier and gate system have only one tuned circuit, and it can be easily aligned using a VTVM. The only requirements for aligning the demodulator circuit are a color signal (either a station or generator signal), a VTVM, and a detector circuit as shown in a typical alignment setup in Fig. 4.

The detector circuit rectifies the 3.58-oscillator signal that appears on G2 of V1 and converts it into a DC voltage to facilitate the adjustment of trap L2. Point A should be temporarily shorted to ground to increase the oscillator strength. Trap L2 is then carefully adjusted for a minimum reading on the VTVM (M2); an incorrectly adjusted trap can affect both the oscillator strength and the color-hue range as viewed

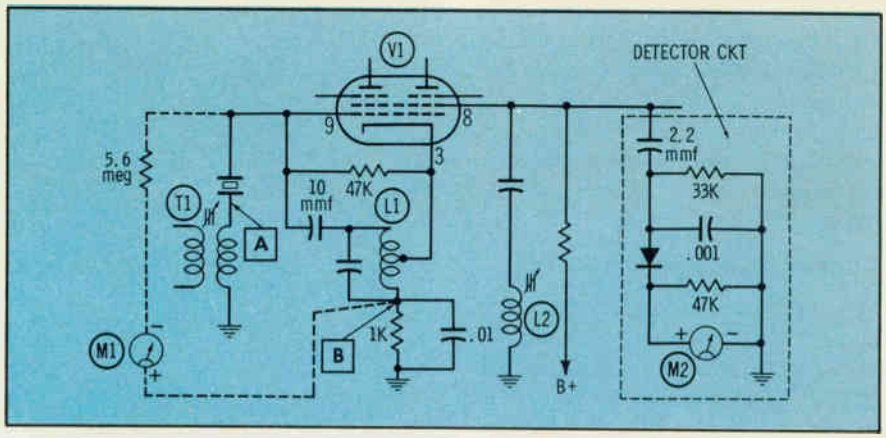


Fig. 4. A typical alignment setup for completing demodulator-circuit adjustments.

on the screen.

Next, the frequency and strength of the oscillator is adjusted. Connect the VTVM in position M1 as shown in Fig. 4. A 5.6-meg resistor must be used in series with the VTVM lead to prevent loading of the oscillator grid. With Point A shorted to chassis, coil L1 is adjusted for a maximum negative reading on the meter; this fixes the adjustment of L1 close to its proper setting.

Now, the short to ground is moved from point A to the cathode of the first color-sync amplifier. The jumper should be approximately 6″ long so the short will not be direct. This shorts out the color sync, as well as most of the chroma, allowing the demodulator to be adjusted. A trace of chroma will be visible on the screen when the chroma control is advanced to maximum.

Transformer T1 should be adjusted for a negative 3 volts. Coil L1 is then readjusted to place the oscillator on the correct frequency. You can determine the correct frequency by observing the screen. The trace of color that is visible should be in place or changing position very slowly when the frequency is correct.

There is some interaction between these two adjustments making it necessary to adjust them alternately until the injection is right (minus 3 volts on VTVM) and the oscillator is on frequency.

The short is now removed and the set checked for color sync by rotating the fine-tuning control in and out of "smear" several times. The color should remain in color sync at all signal levels. The tuning should be stable and remain in adjustment over long periods of time.

The demodulator tube can be changed without materially affecting alignment; however, if alignment is required, it can be done quickly and accurately as outlined. Complete step-by-step alignment instructions are contained in the receiver service manual. The intention here is to outline only the basic principles.

In times to come, some similar demodulation system will find widespread application in our industry. It also should be accepted by the service industry, since combining several functions into one reduces the number of components to be checked during normal servicing procedures.

In the past, Motorola has used a similar circuit in the TS-912 chassis. These sets have now been in service up to two years and have proved very reliable. Motorola experience indicates that once the basic principles of this new circuit is understood, the sets that do require service can be handled efficiently by the serviceman in the field. ▲

Quick Checks With Color-Bar Patterns

Troubleshoot by eliminating a complete section . . . by Ellsworth Ladyman

The first move a service technician makes when servicing a TV chassis, whether it is a b-w or color receiver, determines the profit that will or will not be realized on the project. The first step is, of course, to diagnose the trouble; pin-pointing the defective section accurately and quickly can add immeasurably to the profits of any shop. Improper diagnosis can, and often does, result in much time lost hunting for a non-existent defect in a normally operating circuit. Symptoms evidenced on the CRT can be misleading, due to the interaction of common or related circuits. The symptoms described by a customer can also leave a lot to be desired. Anyone who has heard a customer describe the symptom of "loss of color lock" will agree.

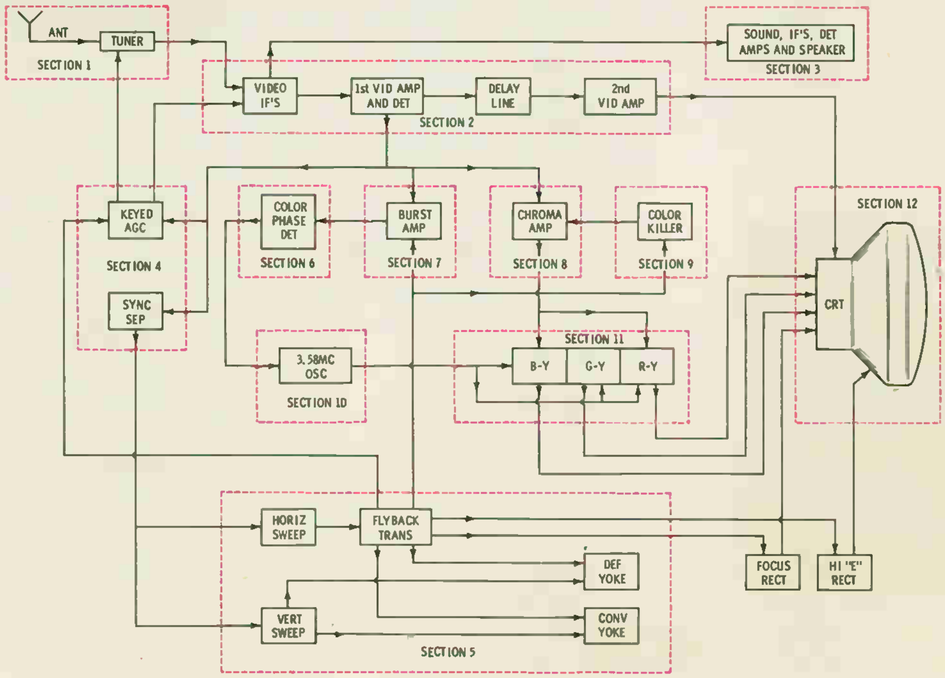
A system comprised of a few "quick-checks" designed to isolate a trouble to a particular area or group of circuits can greatly help to combat the effects of contradictory symptoms. These checks are designed to tell what circuits are working rather than what circuits are defective. If you think of a color chassis as a group of blocks, each block with a specific function, you can proceed with the quick-checks, mentally checking off each area or block as you go. A typical color chassis is laid out in block form in Fig. 1. This particular block diagram may be different from others you have seen, but for "quick checks" it is ideal.

The diagram in Fig. 1 reveals that the front end and the antenna are grouped together for our purposes. This is due to the fact these circuits have to be eliminated as a suspect section in a group. The same holds true for the video IF's. Obviously, a defect in one of the video-IF stages would undermine the output of the entire video-IF section. Quick-checks are intended to isolate defects to a section, not a stage. Therefore, obvious symptoms (such as no horizontal sweep, no vertical sweep, no sound, no picture, etc.) will not be discussed. Defects that present a problem due to a common or interrelated circuitry will be stressed.

The following explanations of each section of the block diagram describes the various functions and responsibilities of the different stages in a color-TV chassis.

1. *Front End:* Antenna orientation and fine tuning are extremely critical in color receivers. A good thing to remember on weak-color, or colored-snow symptoms.
2. *Video IF's:* We are guilty of slight oversimplification here, but it was done for a purpose. Quick checks are designed to

Fig. 1. Sectionalized block diagram.



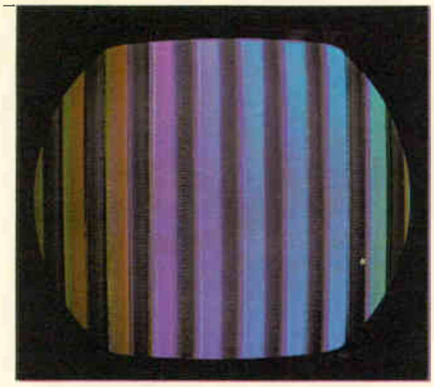


Fig. 2. Normal color-bar pattern.

isolate as much of the chassis as possible in the shortest period of time.

3. *Sound:* The most simple of all checks: "If you can't hear it, you don't have it."
4. *AGC and Sync:* You probably are wondering why we lump these two together? Their functions are practically the same in color chassis as for black and white. The horizontal-oscillator phase is maintained a little closer to prevent improper keying of the burst amplifier; if you can recognize symptoms of trouble in these stages for black and white, you will know the symptoms for color.
5. *Deflection:* The same overall requirements that govern these circuits in black-and-white receivers hold true in color receivers. They are "beefed up" a little, but the symptoms and troubleshooting procedures are about the same in both cases.
6. *Color Phase Detector:* Improves the phase and frequency of the 3.58-mc reference oscillator. In doing so, it furnishes the correction voltage that is necessary to keep the reactance tube on track. Check this stage when color is missing, misplaced, or out of lock.
7. *Burst Amplifier:* Provides amplification of the burst signal; it is keyed into conduction by a horizontal pulse designed to reach the grid simultaneously with the 3.58-mc signal pulse. Check this circuit when symptoms such as misplaced color (out of phase), color off frefrequency, no color lock, or loss of color are present.
8. *Chroma Amplifier:* Strictly an amplifier (bandpass) but can cause trouble; check out when symptoms of weak color, loss of color, etc., are indicated.
9. *Color Killer:* A real "bad actor"; its function is to prevent color contamination of black-and-white reception. It is sometimes a bit overzealous. Check out thoroughly for loss-of-color symptoms.
10. *3.58-mc Oscillator:* A crystal-controlled oscillator capable of being controlled by a reactance tube. Check when symptoms indicate loss of color, color drift, etc.
11. *Color Demodulators:* Diode detection is not possible in this section of color receivers. The out of phase signals arriving from the local oscillator (3.58 mc) and the sidebands (burst amplifier) preclude the use of diodes. The important part these stages play in the final result of color, as indicated on the CRT, make them prime suspects in symptoms such as misplaced colors, loss of colors, etc.
12. *CRT:* A check with a good CRT tester eliminates this stage as a suspect.

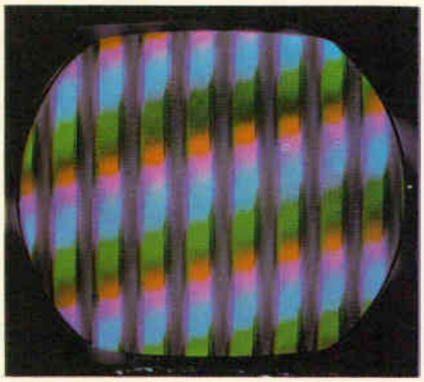


Fig. 3. Loss of color sync. Check the circuitry in sections 6, 7, and 10.

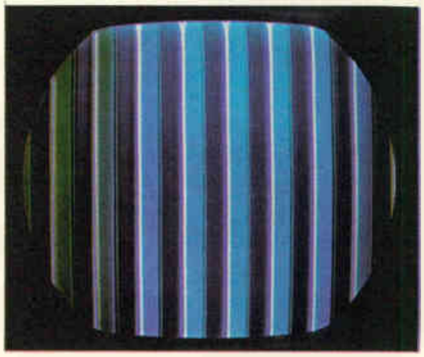
Normal Color-Bar Pattern

See Fig. 2. Notice that the fourth color bar is magenta. The tint control should be centered.

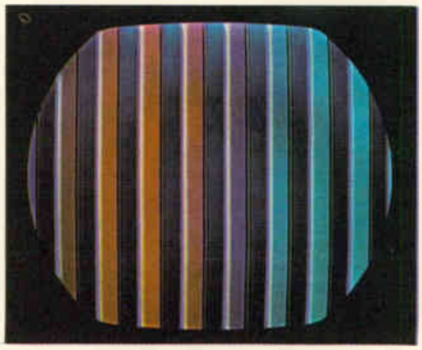
Loss of Color Sync

See Fig. 3. The symptom "loss of color sync" is one which customers are prone to confuse. A quick-check with the color-bar generator, coupled with your observation of the resulting display on the CRT, will eliminate confusion that might arise from seemingly contradictory statements. Check sections 6, 7, and 10.

Once you have established that the color is not locked, you must decide whether it is due to a reactance stage defect or a failure in the burst-keyer or phase-detector circuits. Refer to the service information of the particular chassis concerned, and adjust the frequency (plate circuit, reactance tube) while observing the color-bar display on the CRT. If the color bars can be made to stand vertically and drift horizontally only slowly (much in the manner of horizontal blanking bars on a black-and-white chassis with the AFC diode removed) then tilt in the opposite direction (with further adjustment), the sub-carrier oscillator is operating properly. Move to the color-control circuits, burst keyer, phase detector, etc. The color-bar generator, in conjunction with a wideband oscilloscope, may be used to signal-trace these circuits quite effectively.



(A) Red missing



(B) Most of blue missing

Fig. 4. Check circuitry in section 11.

Weak or Missing Color

See Fig. 4. A weak or missing color should present no problem in diagnosis. However, a quick check of the color-bar display presented by a keyed-rainbow generator will eliminate the possibility of a bright-

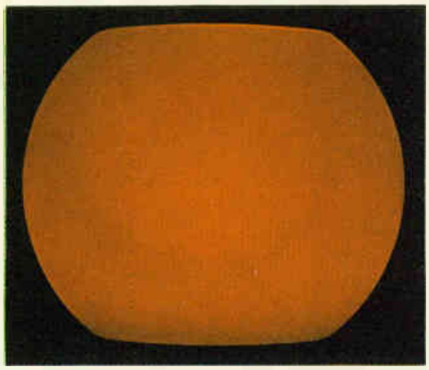


Fig. 5. Purity with red screen test.

ness-level defect. Once the diagnosis is established as the loss of one particular color by observing the color-bar display, eliminate the CRT as a suspect by checking it with a CRT tester. Use of the CRT tester to prove the tube either functional or defective is much faster than taking grid or cathode voltage measurements; these measurements will come later. At this stage, you must be interested in arming yourself with as much information as possible in the shortest possible time. The only circuits of interest are the ones contributing to the development of the lost color. Use the keyed-rainbow generator and oscilloscope; the keyed-rainbow generator to provide a readily recognized waveshape and the scope to trace the signal. Start at the grid of the gun with the defective signal and move backward along the signal path to the demodulator, thereby isolating the defective circuit or component.

No Color

Many times the symptom "no color" results in a service call merely to orient the antenna or adjust the fine tuning control. The first step is to connect a color-bar generator to the receiver and check the display of color bars. Color may be present, but the front end isn't providing it. After having ascertained that the receiver has actually lost color, proceed to the circuits that could be responsible, such as the color killer, chroma amps, etc. Utilize a color-bar generator in conjunction with a scope to trace the chroma signal path.

Final Checks

There are several checks that should be made after every chassis repair is completed. These checks will help to reduce callbacks, and help increase repeat business.

Purity

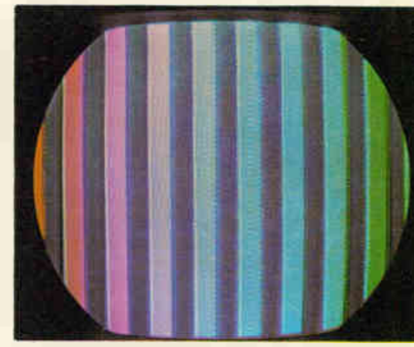
See Fig. 5. Purity adjustments probably sound pretty elementary to most of you, and it is a basic procedure. This still doesn't change the fact that a receiver which has been improperly adjusted for purity is as annoying as, and perhaps even more than, one with no picture at all. Set up for a pure red screen, as illustrated; then, make adjustments as necessary. Also check purity on blue and green.

Convergence

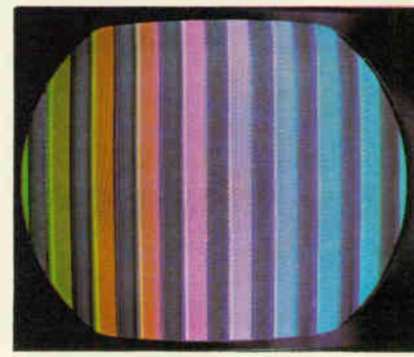
A quick convergence check should also be made. In all probability, little in the way of convergence will be required; this however, is, dependent on the repair work completed. The procedure outlined in this section assumes that all repair work, including convergence has been completed and is meant to be a final inspection before delivery.

Tint Control

Utilize the display of color bars presented by a keyed-rainbow generator. An analysis of these bars will give an indication of the merits of the color-reproduction circuits. Fig. 6A illustrates the pattern with the tint control rotated to the counter-clockwise stop. Fig. 6B illustrates the pattern with the titlt control rotated to the clockwise stop. Notice the shifting of the red bar 30 degrees to the left, then 30 degrees to the right. These conditions offer conclusive proof that all chroma circuits and tint-control operation are normal.



(A) Fully CCW



(B) Maximum CW

Fig. 6. Check effect of tint control.

Conclusion

Quick checks cannot, nor are they meant to, isolate a defect to a single component. They are meant to isolate an area and to eliminate false symptoms and erroneous diagnoses. Once you have completed a series of checks that supply you with conclusive evidence that a circuit is defective, you are not as apt to be misled by an erratic meter measurement, or some mechanical error on your part such as inadvertently touching a probe to one point while thinking of another. ▲

Color Waveform Analysis

Scope traces can tell you a lot . . . if you can read them.

by Larry Allen

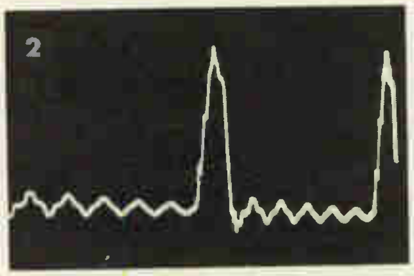
To make this guidebook to color servicing as complete as possible, an exploration of the intricacies of color-TV test waveforms is appropriate. Scope displays are an absolute necessity for consistent troubleshooting success in color receivers, but they are of little value unless you understand them.

The waveforms shown here are from the important chroma circuits in different color sets. Although precise shapes and amplitudes vary from model to model, they are relatively the same in all similar circuits. The comments accompanying them tell how and where each is found, and give some clues as to how they are formed—from what signals and by what circuits.

Study them carefully. Become familiar with them. That familiarity can save you hours on color servicing jobs. Try to understand the characteristics peculiar to each; the knowledge will help you recognize abnormal displays when your scope sniffs them out.

Every chance you get, compare these photos with actual waveforms taken in the circuits of normally operating color receivers. You'll soon be so familiar with them that you'll seldom have to refer to these photos —or their descriptions—at all.

In describing the waveforms in these photographs, we're going to use a bit of special "shorthand." A typical designation, which will be in parentheses, will look like this: (LC, 7875, 250-300V, INT). The letters before the first comma will indicate the type of probe used: LC = low-cap; DP = direct, DEM = demodulator. Preceeding the second comma is the sweep-frequency setting of the scope; 7875 cps shows two 15,750-cps horizontal-rate cycles, and 30 cps shows two fields of 60-cps vertical-rate information. The numbers followed by a V will be the peak-to-peak voltage of the waveform under normal conditions. The final designation will indicate what type of signal is being fed to the color set: INT means the waveform has nothing to do with external signals, but is generated internally and will be the same regardless of RF signal input to the set's tuner; KR means the waveform is caused by a keyed rainbow signal; NT means an NTSC-type color signal is being fed to the set; and STA is for a station signal.

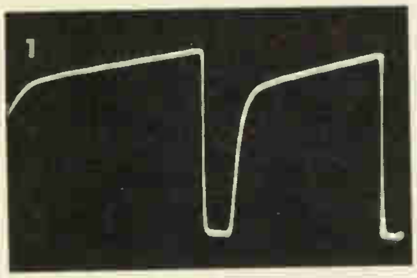


Convergence Waveforms

Photos 1 through 8 show waveforms typical of those fed to and found in Zenith convergence stages. They are grouped for horizontal and vertical convergence, and are arranged to show signal progression through the circuits.

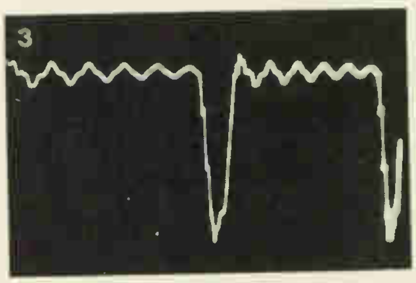
Horizontal

The first, photo 1 (DP, 7875, 250-300V, INT), is taken from a Zenith color set and is the drive waveform at the grid of the horizontal output tube. Note the essentially trapezoidal shape caused by the "knee"; the drive waveform in an RCA-type chassis is smoothly rounded during this portion of the decay, instead of having the knee. Since this is a negative-going waveform, synchronized on the positive slope, it is formed as follows, starting with the downward (negative) excursion: A fast-rise negative pulse of 250-300 volts amplitude is applied to the grid of the horizontal output tube; holds at that level for about 10 usec; starts decaying rather rapidly, dropping to about 75 volts negative in only about 10 usec; then decays more slowly, taking another 40 usec or so to drop back to the starting point. (One horizontal line consumes about 63 usec of time.)

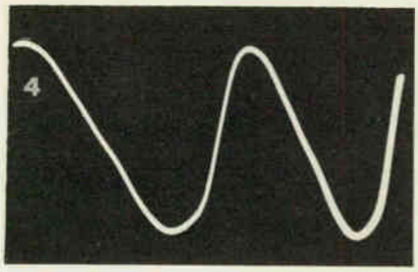


In the RCA chassis, the rounded decay curve simply means that the pulse decays back to zero reference in a logarithmic manner. The shapes are different because of differing characteristics of the output transformer loads in the two sets.

Photos 2 and 3 (DP, 7875, 15V, INT) are both phases of the signal taken from a winding of the horizontal output transformer; these are the input signals that are fed into the horizontal convergence networks. The horizontal pulse itself is

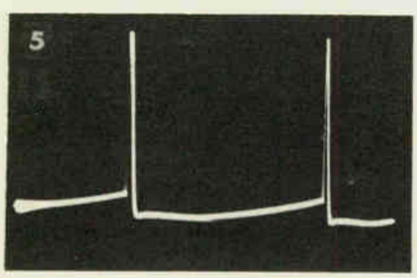


quite prominent, and the ringing seen all along the zero-reference line is caused by the highly inductive loads in the convergence networks. The irregularity of the ringing pulses is because several in-and-out-of-phase natural ringing frequencies are represented in the convergence shaping networks. You can even see the effects of ringing causing jagged edges on the horizontal sync pulse



at this point. Note that the horizontal pulse, from 50% point to 50% point, still takes about one-sixth or 10 usec of the total cycle time. In the RCA chassis, the only real difference is that the ringing is less pronounced.

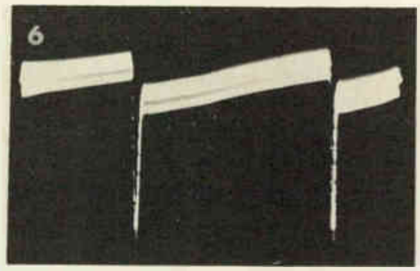
Photo 4 (LC, 7875, 15V, INT) shows the output of each section of the convergence network, the signal that is applied to the horizontal convergence coils themselves. No more is the horizontal pulse noticeable, and all high-frequency ringing has been damped out. What remains is a waveform resembling a sawtooth that has severely rounded points. This voltage waveform, applied to the inductive load presented by the powdered-iron-core convergence



coils, develops current (and magnetic) waveshapes just correct to handle horizontal convergence.

Vertical

Photo 5 (DP, 30, 20V, INT) is taken at the vertical output cathode, and shows only one of the waveforms used in the vertical convergence networks. Remember that this is essentially a negative-going waveform, and is analyzed as follows, starting at tip of first "spike": A



fast-rise negative pulse reaches amplitude of around 20 volts; being an integrated pulse, its decay time is extremely slow, being very gradual and taking over 15 msec (total cycle time is about 17 msec) to decay even 10%; at about that point, the next positive cycle hits the grid of the vertical output tube, causing the sudden decay back to zero reference where we started.

Photos 6 and 7 (DP, 30, 8V, INT) show both phases of the other signal fed to the vertical convergence system. These are taken from windings on the vertical output transformer. (In RCA chassis, the trapezoidal rise lines are not so thick.)

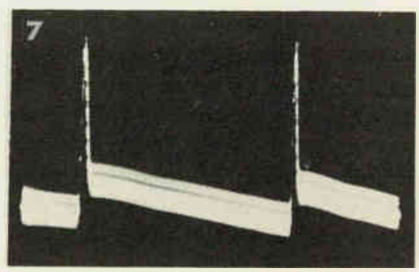
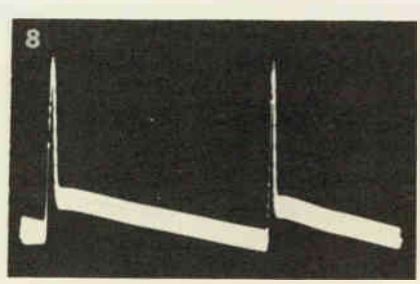


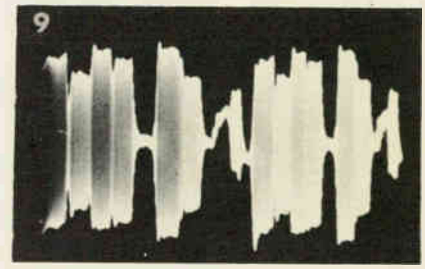
Photo 8 (DP, 30, 70V, INT) is of the waveform seen in the vertical convergence network where all the other waveforms are combined and applied to shaping devices and then to the vertical convergence coils. Note that the shape of the voltage waveform is still trapezoidal to cause the correct current (and magnetic) waveshapes in the inductance of the vertical-convergence coils.

Chroma Bandpass Amps

Waveforms in the chroma bandpass stages (called color IF's by

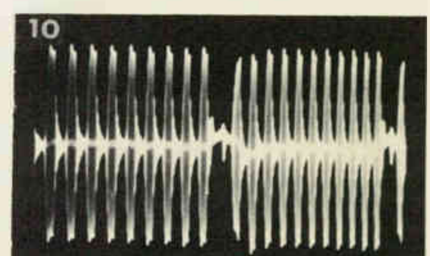


Motorola) depend on the type of signal fed into the set. Those shown in photos 9 through 16 are taken from an RCA CTC-12 chassis with NTSC-type and keyed-rainbow signals, because they are the signals normally used for testing and troubleshooting; station signals are different from these in appearance, and the chroma information is changing so constantly that true evaluation is difficult.

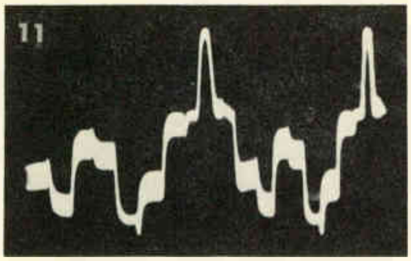


Photos 9 and 10 are the chroma input waveforms taken at the secondary of the chroma take off coil. They are fed directly to the bandpass amplifier grid. Photo 9 (LC, 7875, 6.5V, NT) contains these NTSC color information, starting at left: green bar, yellow bar, red bar, magenta bar, white bar (no color), cyan bar, blue bar, horizontal sync pulse (suppressed considerably), leading up to burst signal, then a very brief period of blanking, and the sequence starts over. Note that the scope is synchronized to the first predominantly positive-going signal following the period of low-level signals (suppressed horizontal pulse and burst). If the scope had synced somewhere else, the sequence would be the same but would start at some other color of bar.

Photo 10 (LC, 7875, 6.5V, KR) shows keyed-rainbow bars fed into the bandpass-amplifier grid from the

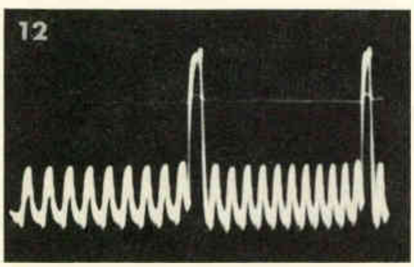


chroma takeoff coil. The scope has synchronized on the first color bar; that's why one burst bar appears "left over" at the right end (on the TV screen, it's hidden by blanking). The sequence of colors in photo 10 is: yellowish-orange, orange, red, magenta, reddish blue, blue, green-



ish blue, cyan, bluish green, green, a tiny trace of horizontal sync pulse that is leaking through, and burst (first large bar in second sequence).

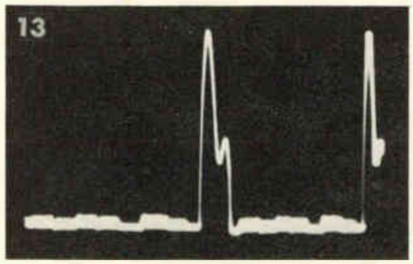
Photos 11 and 12 (LC, 7875, 50V, NT and KR) are of the video (luminance) signals fed from the first video amplifier. In the photos, they are shown just as they come from the video stage; in the set, they are coupled through a small 18-pf capacitor which strips off the sync pulses that are sticking up so prominently above the video signals. Thus the signal actually applied to the bandpass-amp grid is video only, with little sync or blanking informa-



tion (these pulses wouldn't blank, anyway; as you can see, they are positive-going and, being applied to the grid, would increase, not blank, the output pulse).

Compare the video-level steps in photo 11 with the chrominance-bar information in photo 9; you'll be able to count off the bars (which color) in the same sequence, and see the brightness (saturation) level of each. In photo 12, the keyed-rainbow luminance information shows about the same degree of brightness for every bar, which is normal.

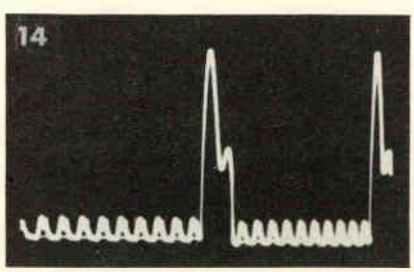
Photos 13 and 14 (LC, 7875, 25V, NT and KR) show a composite signal. Dominating the displays are blanking-signal pulses fed in from the blanker stage (usually taken from the blanker cathode, to provide an impedance match of sorts). Along the base line, you'll notice some of the mixed chrominance and luminance information that is applied to the grid; this appears at the cathode through normal cathode-follower action, although a small-value bypass capacitor (820 pf) reduces it to an insignificant level while allowing the 15,750-cps blanking pulses to remain. The strong positive pulses, applied to the cathode as they are, drive the bandpass-amplifier tube into cutoff during horizontal retrace time—thus keeping burst and sync from reaching the plate circuit.



Photos 15 and 16 (LC, 7875, 4-8V, NT and KR) show the result of all these signals being applied to the chroma bandpass amplifier tubes. Remember: Video luminance) and color (chrominance) information go to the grid, and blanker pulses go to the cathode—result is pure, clean chroma signals that have no burst pulse and no sync pulse between the bars of color information. Note the clean blank space at zero-center between each color-bar sequence. This is the period of blanking, when there is no color in the chroma-bandpass output or reaching the CRT grids.

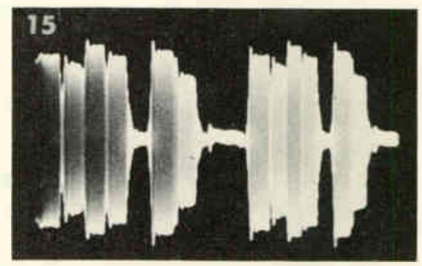
Color Sync

Synchronization of chroma information in the receiver with that in



the station signal is the job of the color sync section. The color-reference burst in the station signal must occur precisely at the beginning of each line—in fact, the burst is positioned at the station exactly on the "back porch" of the horizontal sync pedestal. Furthermore, the set's color-reference oscillator must be in precise phase with the few cycles of 3.58-mc information on the station signal. The entire job is accomplished by comparing — in some rather elaborate circuits — the CW signal from the 3.58-mc oscillator in the set, the incoming chroma signal, and a sample pulse from the horizontal output transformer. Photos 17 through 22 show the waveforms in the color-sync circuits of an RCA-type chassis, of CTC-12 vintage, when a keyed-rainbow signal is used for testing.

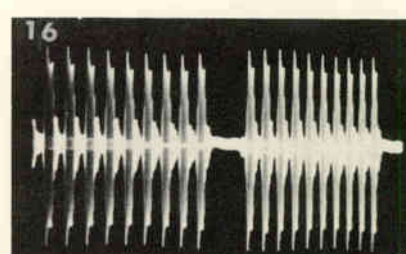
Photo 17 (LC, 7875, 70V, KR) is a video signal brought directly from the video amplifier. Photo 12 shows exactly the same signal. If you recall, the horizontal pulses are stripped off of photo 12's waveform by an 18-pf capacitor in series, before the signal is applied to the bandpass amplifier grid; photo 18 (LC, 7875, 8V, KR) shows the video signal that is left after the 18-pf capacitor. You can see by com-



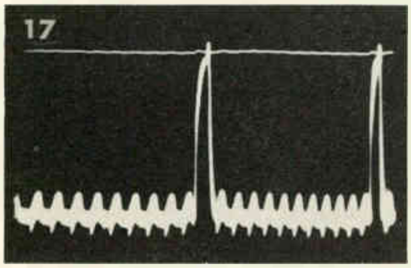
paring photos 17 and 18 that the 8-volt amplitude of 18 is about the same as the video information riding with the 70-volt pulse in 17. The chroma-and-video signal in photo 18 is applied to the grid of a burst amplifer in the color sync section.

Photo 19 (LC, 7875, 90V, INT) is a slightly integrated (not sharply peaked) positive-going sample pulse from the flyback transformer. This sample pulse is applied, along with the video-chroma signal (photo 18), to the grid of the burst amplifier.

The result, at that grid, is the combined waveform of photo 20 (LC, 7875, 60V, KR). If you'll examine this waveform carefully, you'll see that the 8-volt video signal is modulated on the sample pulse (which is reduced to 60 volts in a resistive divider). In fact, even more important, note that the 11

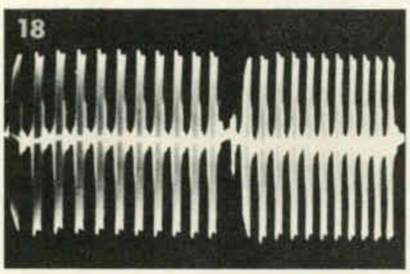


bars of color information (counting burst) that are visible in photo 18 are distributed along the trace-line of the pulse of photo 19. At the pulse tip, you can see the first bar, which is the burst portion of a keyed-rainbow signal. Farther down the slope is the first bar of actual color, and the remaining nine bars



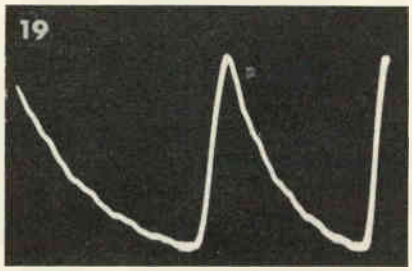
are spaced out at even intervals along the trace.

Photos 21 and 22 (LC, 7875, 90V, KR) are both phases of the burst signal that is developed in the plate circuit of the burst amplifier. Perhaps you wonder how an input signal like photo 20, with the entire 11 bars of color information, can produce a single burst like that in photo 21. The answer is simple, really: The burst amplifier tube is biased at around 40 volts. When the waveform of photo 20 is above that value, the tube conducts and amplifies whatever is appearing at the grid during that interval—in this case, the burst bar. The other bars, as we have already pointed out, are below the 40-volt point and therefore cannot appear in the output. Result—one burst of chroma-synchronizing information, ready to be

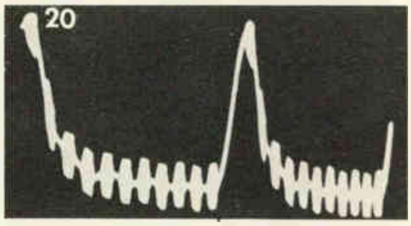


applied to the phase detectors. A burst - amplifier transformer with center tap develops the two opposite phases of 90-volt burst in photos 21 and 22, which are shown as they are applied (through 330-pf capacitors) to the chroma-sync phase detector. The same signals are applied to the killer phase detector, also through 330-pf capacitors.

Photo 23 (LC, 7875, 20V, INT) shows the 3.58-mc CW sample signal from the chroma-reference oscil-



lator. The slight blips that show when the CW signal is synchronized to the 7875-cps scope rate are caused by stray feedthrough of burst pulses; their presence here is totally insignificant. The signal in photo 23 is at the opposite sides of the phase detector from the signals of 21 and 22, having been fed from the chroma-reference oscillator through a 10-pf capacitor. The purpose of course is to compare phase of the signal burst (photos 21 and 22) and

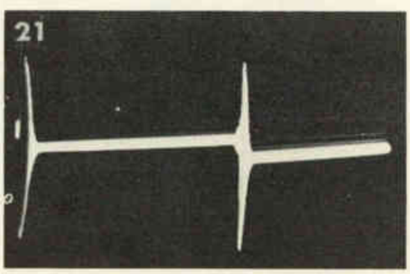


the 3.58-mc oscillator signal; if there is any slight variance, the phase detector develops a correction voltage for the oscillator control tube.

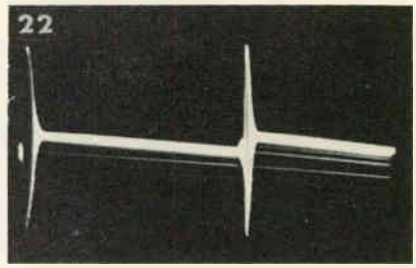
Luminance Waveforms

The luminance channel of a color set is only slightly different from the video amplifier in a black-and-white receiver. The color set generally has a little better video response, there is a delay line to slow the video down so it gets to the CRT at the same time as the color information, and DC coupling or some form of DC restoration is usually included to assure proper black levels. The waveforms we're showing in photos 24 through 26 are similar to those in b-w sets, but they're shown so you'll be familiar with their composition.

In photo 24 (DP, 30, 1V, STA)



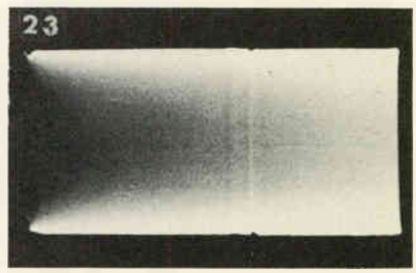
is the composite video waveform following the delay line (which affects only the phase, not the makeup of the waveform), taken at the grid of the video output tube. The signal is negative-going (since the sync tips go in a negative direction), but the scope for this photo was set for positive (+) sync; the display thus is locked on the most promi-



nent positive element of video (visible plainly in the second frame) and both vertical sync pulses are in plain sight—if the scope's switch were changed to negative (−), the trace would lock on one vertical pulse and only the other would be easy to see.

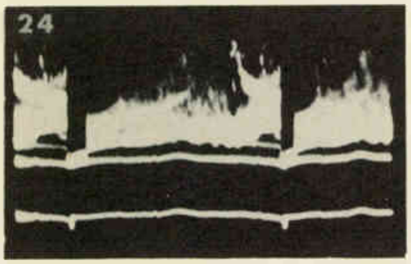
The line just below the video information is formed by the presence of 262½ horizontal-blanking pedestals, arranged side by side between the vertical-pulse pedestals (a few of the 262½ are actually a part of the vertical pulse). The line at the bottom is formed by the tips of the horizontal sync pulses.

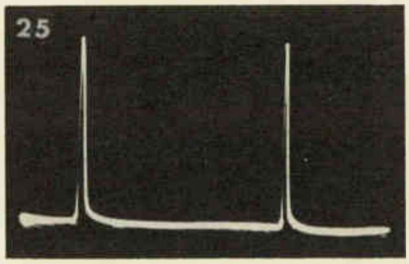
Photo 25 (LC, 30, 900V, INT) is of the vertical-retrace blanking pulses fed to the plate circuit of the video amplifier to mix with the am-

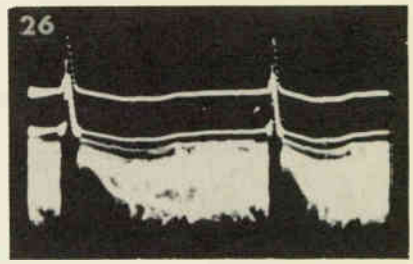


plified video. They originate in the vertical output circuit and timed so they occur just at the point of vertical sweep retrace on the CRT.

Photo 26 (LC, 30, 70V, STA) shows the composite video waveform with the blanking pulse added (through a dropping resistor, of course), as they are both applied to the cathodes of the color CRT. Keep in mind two factors as we analyze this waveform: The CRT is so biased that any voltage beyond about 35 volts positive, applied to

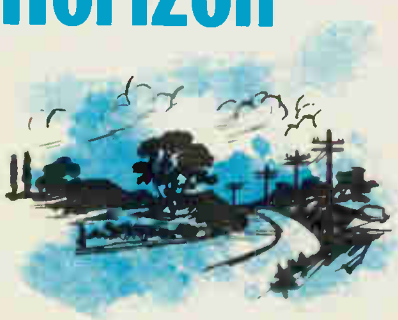






the cathode, holds the CRT gun beyond cutoff. Thus everything above the pedestals in this waveform is kept from appearing on the screen; this portion of the composite signal from the pedestals upward is called "in the blacker-than-black." To prevent any slight ringing in the highly peaked video circuit from causing vertical retrace lines — or portions of them—to appear on the screen, the blanking pulse can be seen "pushing" the vertical-pulse tip well into the blacker-than-black region—even beyond the sync tips.▲

Beyond the Blue (Red and Green) Horizon



Fringe-area servicing has problems all its own.

by Jack Darr

Fig. 1. Signal from Tulsa, 145 miles.

The population explosion in color TV has had a fallout in the deep fringe areas. Color sets around our little town have increased by 5000% (one set 10 years ago, over fifty now). The "local" station is 87 mountainous miles away; other stations are 95, 100, and 205 miles away, over equally rugged terrain. All this is over-the-horizon propagation and, according to the experts, is impossible. Don't tell 'em, but we're getting pretty good pictures on all three networks (see Fig. 1)!

You'd think b-w reception would give enough trouble here, without the added complexity of color. We did too, until we tried it. The reception on a good color set is as clear in our area as in metropolitan areas. However, the sets must be in perfect condition, because we work with signal levels as low as 6 uv.

Cochannel interference, fading, and noise are our most bothersome reception problem. These troubles are usually temporary, and the rural viewer is of necessity far more tolerant of such interruptions than his city cousin is. These owners are familiar with how their sets work and are able to make minor adjustments without yelling for a technician. However, there are times when a technician is needed, and that's where you come in.

Antennas

The key to successful color reception in the fringe areas is the antenna. Only the very hottest antennas will do. Fig. 2 shows a typical installation. Antenna-mounted boosters with very low noise figures, such as the Nuvistor and transistor types, give good results in removing snow.

Receiving more than one station on the same channel is common. We've got three channel 4's, and the only way to sort them out is by rotating a highly directional antenna. A color TV antenna for deep-fringe reception must have a long, sharp frontal lobe and a high front-to-back (FTB) ratio. Whenever possible, open-wire line is used for its long life and low loss.

Sometimes you find a locality where sound from channel 5 makes herringbone patterns on channel 6. In these areas, the FTB ratio becomes very important. In extreme cases, sharply tuned adjacent-channel traps can be used to reduce the interfering herringbone.

One peculiarity found in our area is that maximum signal strength is only 30′ above ground! The 100′ fringe-area towers of a few years ago are gone (with the wind, in some cases). No layering of signal is apparent here.

If a hill blocks us from a TV station, we just put the antenna on top of it. Open-wire line will carry signals for amazing distances, even without boosters. We have several installations with over 1300′ of line between the antenna and receivers. High-band attenuation is much greater in long runs, so boosters are used. They are especially helpful if their response is "tilted" to increase high-band gain.

Reception

Overall reception is good on all three networks. There are the inevitable disturbances, but these don't bother on color as much as on b-w! In fact, in a deep fade, a color pic-

Fig. 2. Elaborate antennas are a necessity in rural and fringe areas.

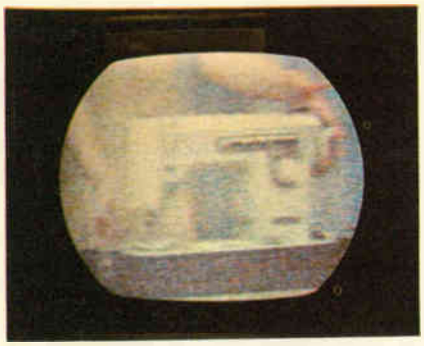


Fig. 3. Color signal is last to fade.

ture is actually visible longer. The last things to disappear will be the color objects, leaving the picture resembling an electronic Cheshire cat (Fig. 3)!

Since we receive color programs on more than one channel from the same network, now and then we can see color differences between stations. Hue controls need readjustment, or the color saturation needs changing. These color variations can result from differences in the transmission path, in the telephone company's terminating amplifiers at the city or origin, or in the TV transmitters themselves.

Some stations have good color coverage in their primary areas, but poor or none in the fringe. This may be due to low burst level, or weak chroma, but this is not a set fault. For a valid test, try the same program on a different station.

Noise is a big problem, especially if the set is located near a busy highway. Color sets, and their antennas, have very high RF gain. You can often see screen indications of a car approaching from a mile away! Most sets use noise-cancelling circuits, which do help. Fig. 4 shows a severe case of ignition interference. High-pass filtering in the antenna doesn't seem to offer much improvement.

Line noise from the long REA power lines can also be a problem, especially in dry weather. This interference shows up as two horizontal lines of dots across the screen, similar to those in b-w, except that these are prettier— they're colored. Noise of this type does not interfere with color registration. Since most antennas out here use rotators, the location of interference can be pinpointed by aiming the antenna in the direction of maximum interference. A call to the REA office will bring a crew promptly to correct the trouble.

Servicing

Technicians around here have adjusted very well to servicing color. A few years ago they were scared to death of it; but with the abundant servicing information available from service clinics and technical magazines, the country boys are handling color with ease.

Because of low signal levels, our troubleshooting must be very thorough. For example, an RF-amplifier tube that could give far more use in a strong-signal area would have to be replaced out here because of excess snow, etc. Fortunately for us, color sets take no design shortcuts, making good performance much easier to obtain.

We do have to watch adjustments, and be on the alert for IF tubes with grid emission. AGC settings aren't a lot different than in b-w sets, but they are critical—AGC affects color greatly in low-signal areas.

Color killers mustn't be set too tight, as the constantly varying signals will cause color dropouts. In fact, most of the color-set owners prefer having the killer set pretty loose, and simply turning the color control off if they get too much confetti.

Fig. 4. Severe noise on the color set can easily "wipe out" the picture.

Color alignment is critical; but, the color sets seem to have very little actual drift. The full realignment jobs that have been necessary can be attributed to "screwdriver drift." Even this is rare, since the do-it-yourselfer isn't the problem in color sets that he is in b-w. The typical farmer—used to doing things for himself—has a tendency to try fixing his b-w set. With color sets, our DIY's are a little hesitant, possibly because of the publicity given to the "Terrible High Voltage." While his leaving the set alone cuts down on the gross profit of your service job, it makes the work a lot easier in the long run.

Summing Up

Color TV service work in the rural areas can be quite profitable and not too difficult. Antenna installations are elaborate, meaning more income. Antenna maintenance work can usually be done in your spare time. After checking out a color set, make it a point to inspect the antenna; look for signs of deterioration in the leadin, loose guy wires, and so on. Above all, on new-set installations, show the customer how to operate his set, it's a lot easier than making a 20-mile service call on a dark night just to turn up the color control! ▲

the inside story on... PINCUSHIONING

Antipincushioning circuits for 90° CRT's.

by Carl Babcoke

Another descriptive term has enriched the vocabulary of the color TV technician with the introduction of rectangular color picture tubes. That word is "pincushioning" and it refers to the stretching out of all four corners of the picture. Fig. 1 shows the shape of the vertical and horizontal lines in a raster with pincushioning. The corners show more "stretch" distortion since they are farthest from the center. Notice there is more bending near the edges; the center lines are straight. Pincushioning is a product of wide-angle deflection and has little to do with the rectangular tube shape, but more with the flatness of the CRT face.

Another product of wide-angle deflection is elongation of the scanning spot as it nears the edge of the CRT screen. This effect is know as aperture distortion; the symptom is a loss of high-frequency detail.

Pincushioning is easily reduced in b-w sets by adding permanent magnets around the yoke; the magnet fields push the corners back into

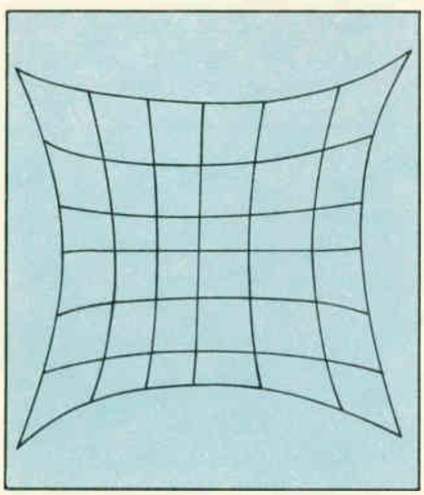


Fig. 1. Exaggeration of pincushioning.

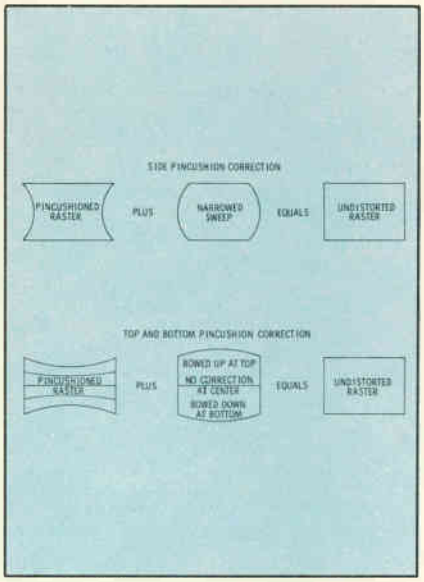


Fig. 2. Corrections—side or top-bottom.

line. In most late-model sets, the magnets are included in the plastic covering of the yoke itself. This simple method cannot be used with three-gun color tubes because the amount of corner correction would be different for each color, and magnets would make good convergence impossible.

Theory of Dynamic Correction

All the present manufacturers of rectangular color receivers use a dynamic system of modifying the height and width, for this method will provide equal correction for all three guns. Side pincushioning is corrected by *subtracting* from horizontal deflection width at the top and bottom of the vertical scan. Top and bottom pincushioning is corrected by *adding* to the vertical sweep at the center of each line near the top and bottom of the raster. Fig. 2 shows what correction is needed. Since the sweep circuits are modified, no extra magnets or yokes are used.

In Motorola

The Motorola TS908 chassis — Fig. 3 — corrects side pincushioning by changing the high-voltage regulator current. A parabolic vertical voltage is fed to the 6BK4 grid so more current is drawn through the high voltage regulator at the beginning and end of each vertical field. So that reversal is not necessary, maximum current flows during vertical retrace time. The increased current loads down the horizontal-output circuit and thus reduces the width. The high voltage is actually changed little because of the storage effect of the high-voltage filter capacitor. No adjustment of pincushioning effect is provided.

In RCA

RCA CTC17 and Admiral G1263-1 chassis use a modernized version of the old saturable reactor to correct side pincushioning. Since saturable reactors are not normally used in TV receivers, a little background information further along will clarify the operation of this kind of magnetic amplifier.

In Zenith

The Zenith 25MC36 chassis narrows the width dynamically with a vertical parabolic voltage obtained from the output of the vertical-out-

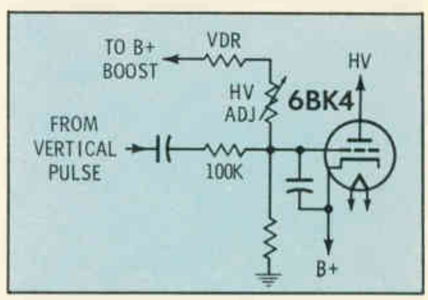


Fig. 3. Circuit for a Motorola TS 908.

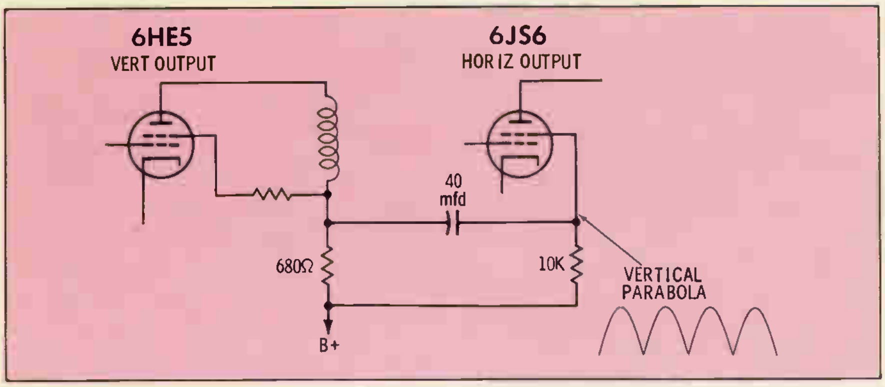


Fig. 4. Antipincushioning circuit in the Zenith 25MC36, new 25" chassis.

put tube and coupled to the screen grid of the horizontal-output tube, as in Fig. 4. The polarity of the vertical parabola reduces the screen voltage (and thus the width) at the top and bottom of each vertical scan. No variable adjustment is provided.

Saturable Reactor System

Fig. 5A shows that raster width can be changed by choosing different taps on the flyback transformer, and this changes the width the same amount at the top, middle, and bottom of the raster. A potentiometer (Fig. 5B) could be used to give a smooth adjustment between the taps, but this still would permit only an overall change. Since an inductance acts as a resistor at one frequency, the pot could be replaced by two variable coils in a system whereby one is increased in inductance when the other is decreased (Fig. 5C). It would also be theoretically possible for this circuit to be activated by a motor-and-cam arrangement to move both cores in sync with the vertical sweep so that the raster could be narrowed at the top and bottom. That idea is obviously much too cumbersome. *Saturable reactors*, however, offer a sophisticated solution since their inductance can be changed without any moving parts.

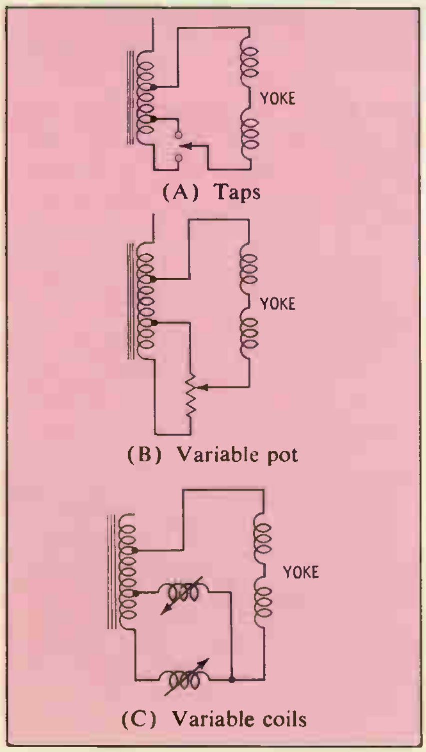


Fig. 5. Ways to obtain width changes.

All transformers and coils have some saturable characteristics, but in most transformers this effect is undesirable. The true saturable reactor is designed to make efficient use of this side effect. A typical saturable reactor (Fig. 6) has one or more control windings on the center core, and two load windings on the outside legs of the core. The two load windings are wound in opposite phase, so that any AC present in the control winding cannot appear in the load windings and so that any voltage across the load windings will not appear across the control winding.

Current in the control winding determines the reluctance of the core, and the core reluctance determines the true inductance of the load windings.

If the simple variable coils of Fig. 5C are replaced by the load windings of two saturable reactors, the circuit becomes that of Fig. 7, which is a simplified diagram of the saturable reactor in RCA's CTC17.

A small amount of direct current from a 2-to-4 volt source is fed to the two control windings in series to set the correct operating inductance point. This current is factory-adjusted with a hidden pot, and should not be retouched in the field. The vertical-control pulse is fed to the two control windings in parallel; the capacitor acts as AC ground for the

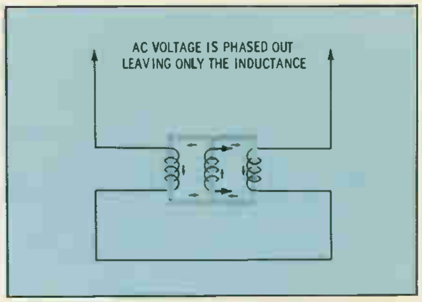


Fig. 6. Magnetics of saturable reactor.

one winding. One reactor will therefore be increasing in inductance when the other is decreasing, and vice-versa, as was described in Fig. 5C. Both of these saturable reactors, sometimes called modulators, are mounted together in one assembly as shown in Fig. 8.

Top and Bottom Correction

Pincushion correction at top and bottom is much more complicated than side correction since a direct reduction in vertical height probably would make the vertical multivibrator unstable. Instead, vertical scan must be increased only where needed (refer back to Fig. 2). There is one large problem: the phase needed for top correction is opposite to that for bottom correction. The horizontal scanning lines at the top must be bowed up in the middle until crosshatch lines are straight; this correction must diminish as the raster approaches the middle of the vertical scan, where no correction is needed. Downward from the middle, the correction must gradually increase (but in opposite phase) until maximum downward bowing occurs at the bottom. During vertical retrace time the phase is reversed very quickly. Thus, the phase of the correction waveform must be reversed twice for each vertical scan—once in the middle of the raster where the correction is at minimum, and again during vertical retrace when correc-

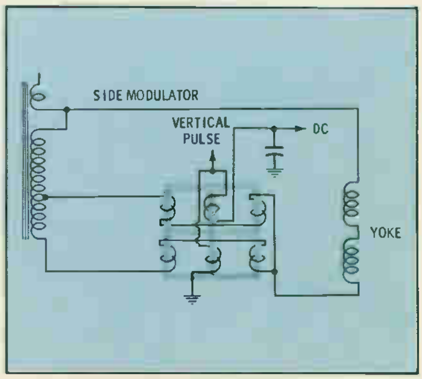


Fig. 7. Circuit of unit in use by RCA.

tion is at maximum. Motorola and Zenith both use the variable gain of a tube to perform this phase and amplitude change, but details differ considerably.

Motorola

The Motorola TS908 simplified diagram is shown in Fig. 9. The vertical-deflection sawtooth is fed to the grid of the 6BM8 tube to vary the gain linearly, so at the bottom of the raster the tube has minimum gain. A fixed amount of parabolic horizontal voltage is fed to T230 through C231. Some of the same horizontal signal is also fed to the cathode of the tube where it is amplified, but not phase-inverted. At the top of the raster, the tube gain is maximum and the signal in one side of T230 is much larger than the fixed amplitude in the other side. There is some cancellation, but the

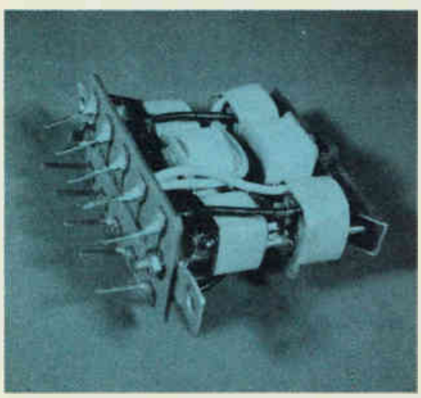


Fig. 8. "Modulator" reactor in CTC17.

phase of the secondary voltage is then determined mostly by the dominant first side. These two conditions of operation, applied as they are to the yoke, will correct the extreme top and bottom. At the middle of the vertical scan period, these two voltages must equal each other exactly and thus cancel because of push-pull action in the transformer.

Two adjustments are provided: R233 in the cathode circuit sets tube gain for the maximum correction needed at the top of the raster. L230 adjusts the bottom correction; L230 and C230 form a series-resonant circuit tuned approximately to 12 kc; the circuit functions mainly as an amplitude control and has little effect on phase. A phase change would "tilt" the correction.

Zenith

The Zenith 25MC36 simplified schematic is shown in Fig. 10. A

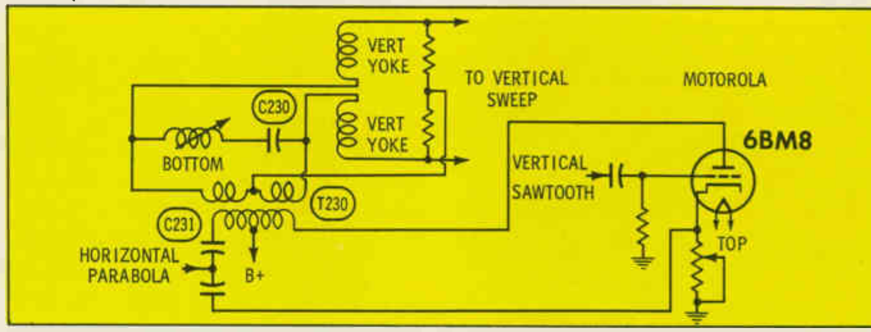


Fig. 9. Motorola antipincushioning circuit to correct top and bottom.

fixed amount of horizontal parabola is fed to T9 and to the 6C4 tube. A vertical sawtooth (to vary the gain) is fed to the grid of the tube with the horizontal parabola; inversion of both takes place in the tube. At the top of the raster where tube gain is high, T9 parabolic voltage phase is mostly that of the tube, since the signal from C56 is mostly overriden. In the middle of the vertical scan, the tube output is equal to the voltage from C56, and cancellation takes place because of the opposite phase. At the bottom of the raster, the tube is cut off, and correction depends on the fixed voltage from C56.

C54 and T9 resonate at approximately 15,750 cps, so adjustment of T9 changes the tilt of the correction rather than the amplitude. To adjust it, just watch a crosshatch pattern and adjust T9 until the top line is straight and parallel with the center horizontal line. The bottom is not visually critical, and is adjusted automatically when the top is set.

RCA's Switching Reactor

The RCA CTC17 uses another variation of the saturable reactor, and some more study of magnetic applications should be helpful. The inductance of a coil can be altered by a change in the core material or by varying the number of turns of wire. Powdered-iron-core coil characteristics are changed by withdrawing the core from the coil; the coil loses inductance just as though it had fewer turns.

A change in magnetic reluctance of the core will also change the inductance as though the number of turns were different. In the reactor described in side-pincushioning correction, the core inside each load winding changed reluctance the same, so the balance was always equal. This is not true of the switching reactor used in the top-and-bottom pincushioning corrector.

To explain this new effect, let us consider two transformer windings with a common core (Fig. 11A). If we withdraw the core from the output winding, the voltage induced there will be lowered just as though we had reduced the number of turns. Now let's assume a three-winding transformer (Fig. 11B) in which the input is to the two outside windings, which are wired opposite in phase so their effect will be canceled. If we withdraw the core from input winding A, that winding will have the effect of fewer turns. The two windings will no longer be balanced, and

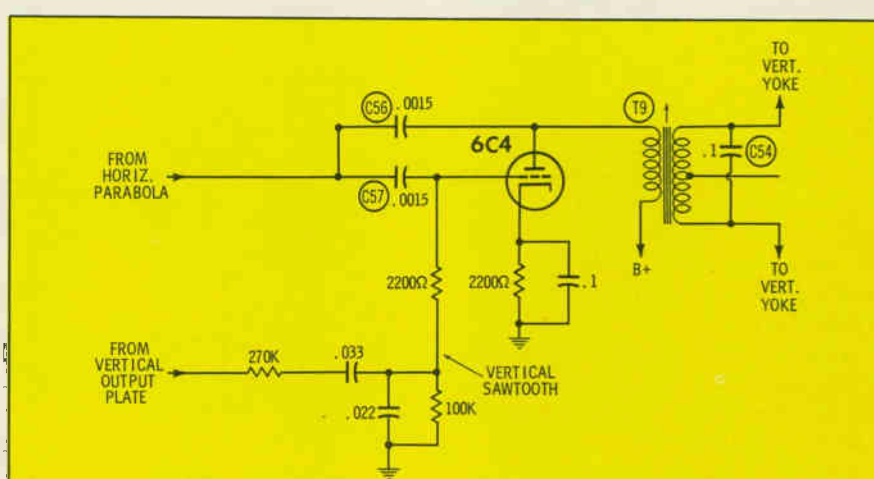
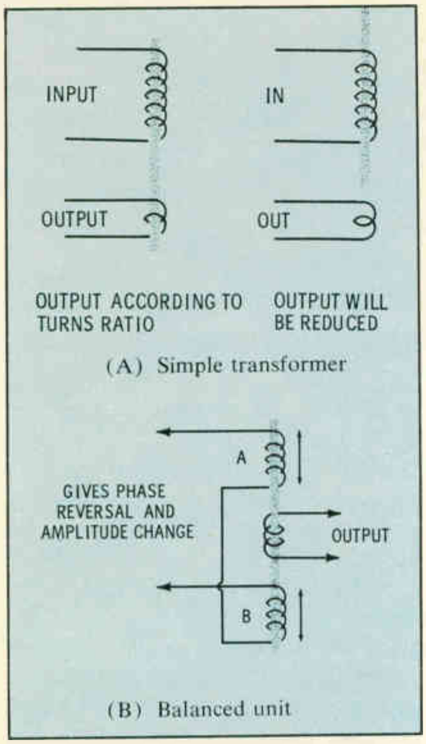


Fig. 10. Zenith's top-bottom circuit uses horizontal and vertical samples.



(A) Simple transformer

(B) Balanced unit

Fig. 11. Effects of shifting iron core.

thus the output winding will have voltage induced. If the core is withdrawn instead from winding B, the output winding will develop a voltage but of opposite phase. From this we may assume that such a transformer will alternately give an output that varies in phase as the core reluctances of the input windings are changed back and forth.

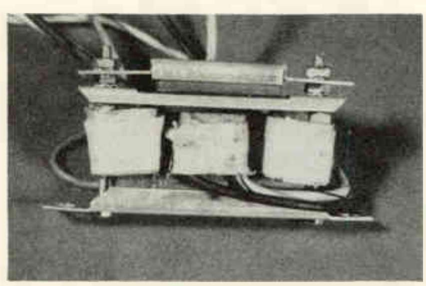
Instead of a mechanical core variation, the core reluctance can be changed effectively by a permanent magnet and a control voltage. Fig. 12A shows a picture of the switching reactor used in the RCA CTC17 chassis, and Fig. 12B shows a magnetic diagram of it. With no AC on the control winding on the middle leg of the core, the two outside windings equal each other in reactance because the permanent magnet affects both the same. A DC current fed into the control winding would add a magnetic field on one side of the core and subtract one from the other. This would raise the inductance of one winding and lower the other. A direct current of opposite polarity would reverse these conditions.

This alternate unbalancing of the windings would not by itself help us. Let us, however, assume a similar transformer (Fig. 13) with an extra winding on the center leg of the core, to be operated under these conditions: horizontal pulse to the two outside windings, 60-cps sawtooth to one of the middle windings, and a scope connected to look at the waveform developed in the other middle winding. We could expect to see a series of pulses with the sawtooth outline quite clear (Fig. 14A). Notice that there is a cancellation each time the sawtooth passes through the middle line, the zero reference point. If we filter the pulses with a ringing circuit, the waveform should be as shown in Fig. 14B, which is identical with that in the Motorola and Zenith circuits.

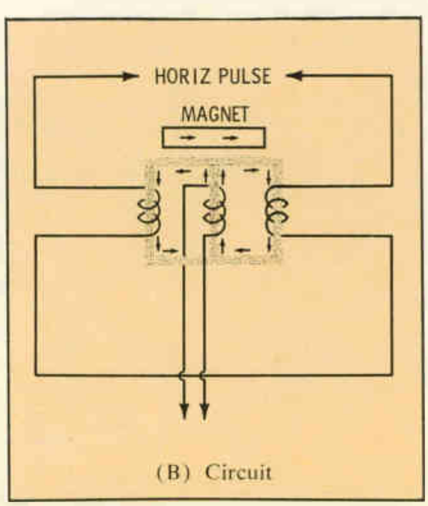
The simplified CTC17 circuit is shown in Fig. 15. A horizontal sawtooth of current goes through the two outside windings of the switching reactor on its way to the horizontal deflection yoke. When there is no AC on the two control windings on the center core leg, there is virtually no horizontal voltage developed in the outer windings, because of cancellation. This is also the case whenever the control-winding AC signal crosses zero reference.

But, in normal operation, there is a vertical sawtooth of current passing through the two control windings; the path is from one vertical yoke coil through a control winding through one tilt coil, back through the other tilt coil and control winding to the other yoke coil. This vertical sawtooth affects the reluctance of the outer legs of the core, on which the horizontal windings are mounted. One horizontal winding becomes higher in inductance than the other; on the other half of the sawtooth the inductances are reversed. This action develops a horizontal pulse in the two center windings of a phase and amplitude (Fig. 14A) determined by the instantaneous inductances of the two outer windings, which are in turn the result of the vertical sawtooth. These pulses are filtered into sine waves (Fig. 14B) by the tilt coil and the .18-mfd capacitor.

These horizontal sine waves are added to the vertical sweep to correct the top and bottom pincushioning. The sine wave must arrive at the correct time to correct parabolic bending (Fig. 2B), and this is the function of the titl-coil adjustment; it changes the phase, which moves the sine wave to one side or the other. The amplitude control is really a Q adjustment and changes the amount of correction. Did you notice that the two switching-reactor center-core windings actually do double duty? They supply the verti-



(A) Side view



(B) Circuit

Fig. 12. Switching reactor with magnet.

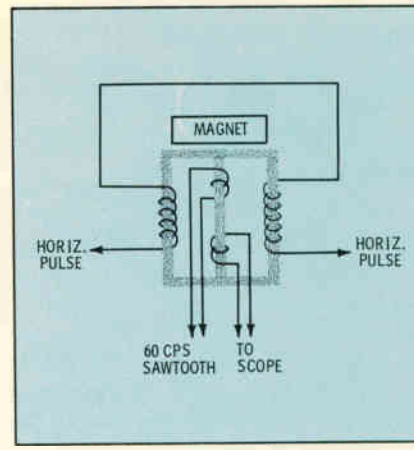
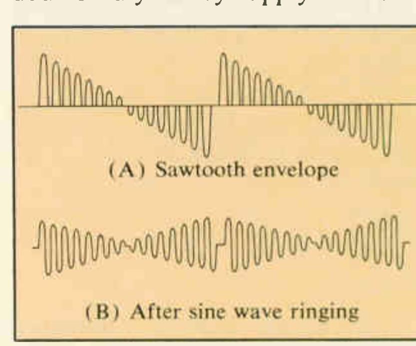


Fig. 13. Extra winding for scope view.


(A) Sawtooth envelope

(B) After sine wave ringing

Fig. 14. Patterns formed in the reactor.

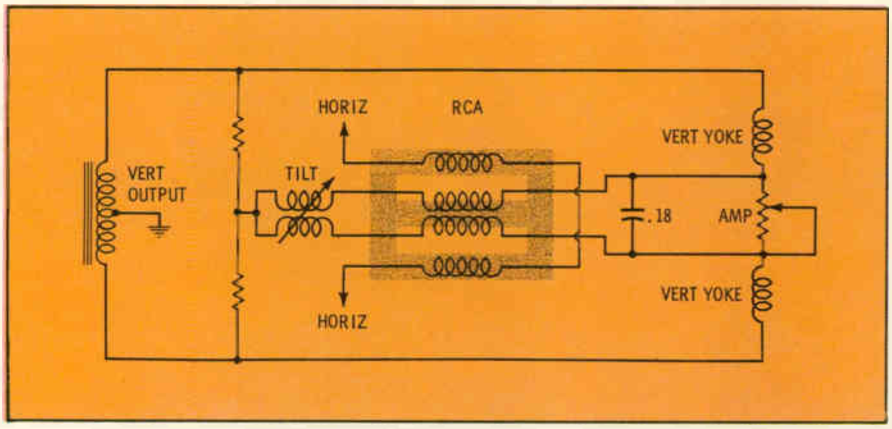
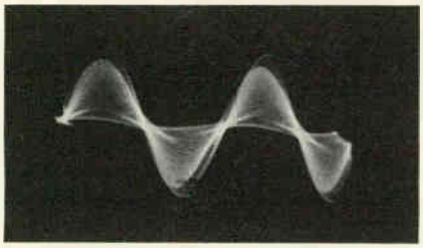
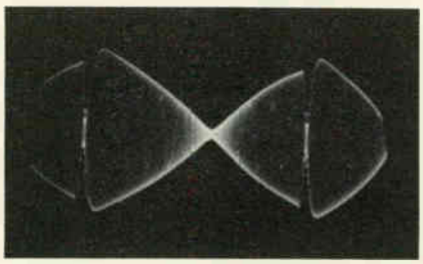


Fig. 15. Circuit from RCA and Admiral sets of the CTC17 class.



(A) 7875 cps



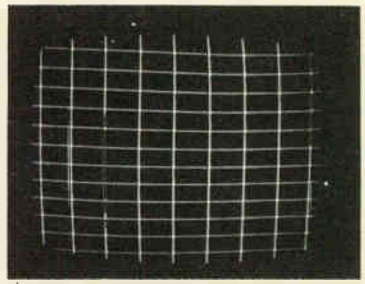
(B) 30 cps

Fig. 16. Top-bottom correction signals.

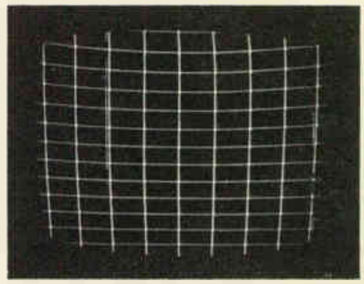
cal control sawtooth, and they also receive the resultant horizontal pulses when any winding unbalance is caused by the sawtooth. Fig. 16 shows the pincushion - correction waveform across the amplitude control at both horizontal and vertical scope frequencies.

Adjusting

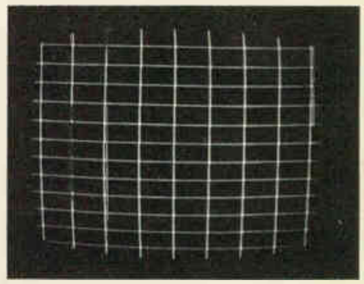
After the long and involved explanation of the inner workings of this circuit, the adjustment is an anticlimax—it is so simple. Observe the CRT with a crosshatch pattern (Fig. 17), set amplitude control clockwise for maximum, then tune the tilt coil so that the upward bowing of the top horizontal bar is exactly in the middle. Reduce the amplitude control so that the first complete top horizontal crosshatch bar is straight when you have your eyes level with the bar. The last step is to compromise any viewing error, by adjusting top and bottom simultaneously. Fig. 17A shows the effect of improper tilt adjustment, 17B the look of no amplitude,



(A) Showing tilt



(B) Amplitude minimum



(C) Normal (ignore camera distortion)

Fig. 17. Photos of crosshatch used in adjusting the antipincushioning circuits.

and 17C a correctly adjusted raster. (The slight bowing of all the lines in 17C is caused by camera distortion; the raster lines were actually straight.) ▲

Advertisers' Index

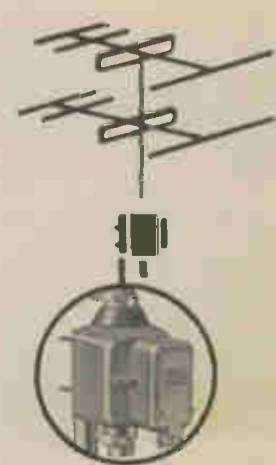
Completely transistorized

TEAR AT DOTTED LINE AND MAIL TODAY. NO POSTAGE NECESSARY.

the NEW Alliance Tenna-Rotor®

TV's better color getter...

The new C-225 Alliance Tenna-Rotor is completely transistorized featuring a patented phase-sensing bridge circuit designed from scientific laboratory test equipment, now available to afford the discriminating color TV and FM stereo owner the ultimate in reception providing:



• silent operation • accurate repeatability • constant synchronization • greater sensitivity onger life and dependability

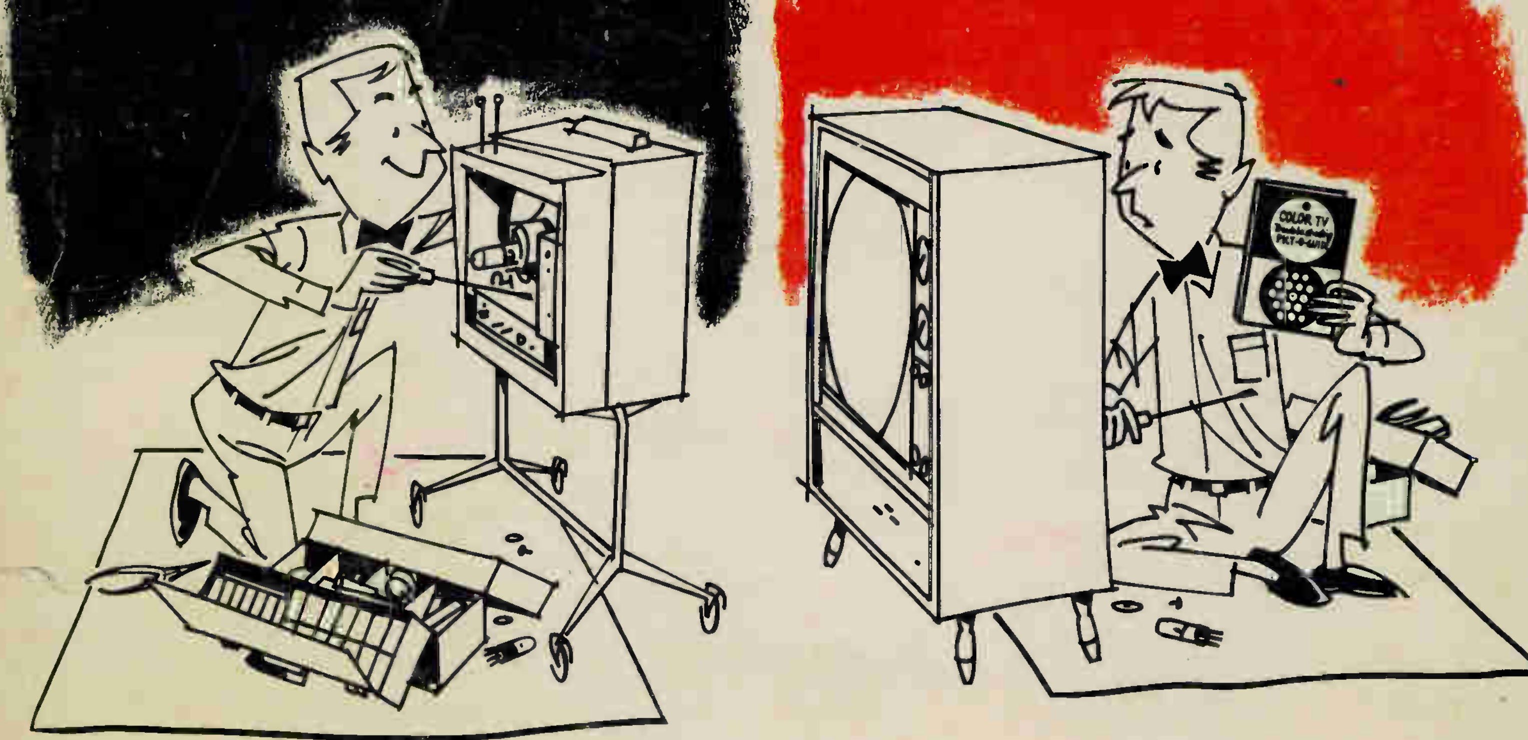
e it now! Sell it now! It means added sales and profits to you. The C-225 is the biggest vance in antenna rotation in 10 years; and, of course it's from the world's leading manu-cturer of antenna rotating devices.

mplete promotional materials are available. For further details write today to:

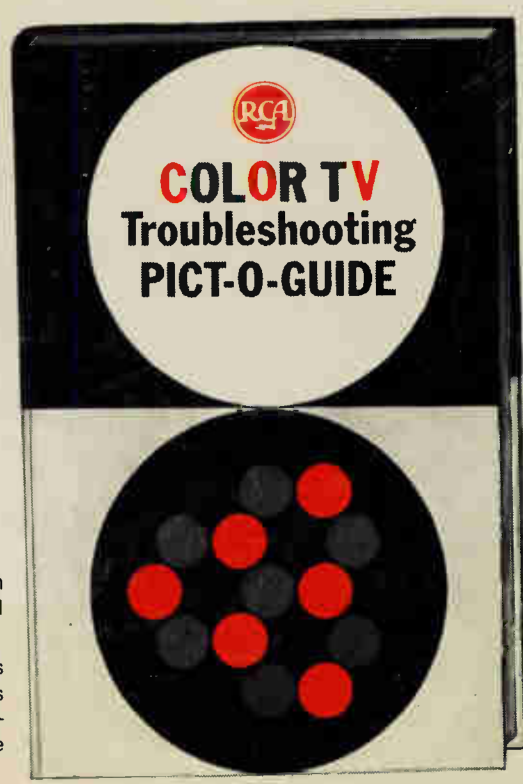
Alliance Manufacturing Co., Inc., Alliance, Ohio
(Subsidiary of Consolidated Electronic Industries Corp.) Dept. 225

LINE AND MAIL TO SAMS DISTRIBUTOR

Your black and white skills are not enough for Color TV



You need this book to help you cash in on Color TV business



(For a complete course in the principles and practices of color TV you will find the 8 lesson Color TV Home Study Course by RCA Institutes, 1A1325, invaluable.)

NEW RCA COLOR TV TROUBLESHOOTING PICT-O-GUIDE, 1A1389

You're missing more and more chances for profit if you're not in color TV service. There are 3 million color sets in use now . . . and the total should be at least 5 million by the end of the year.

The new, completely revised RCA Color TV Pict-O-Guide, with its many color photos and illustrated step-by-step instructions makes it possible for you to recognize and understand the visible symptoms of troubles and maladjustments in color receivers. Use the Pict-O-Guide whenever you work on a color set.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.

WHAT THE RCA COLOR TV PICT-O-GUIDE GIVES YOU:

- ☐ Color Fundamentals
- ☐ Receiver Set-Up
- ☐ Functions of the Color Set Controls
- ☐ How to Use Color Test Equipment
- ☐ Troubleshooting Color and Black and White Sections of Receiver
- ☐ Servicing and Alignment Techniques

...and much, much more. 150 pages. *This book should more than pay for itself the first time you use it.*

ORDER THROUGH YOUR LOCAL AUTHORIZED RCA TUBE DISTRIBUTOR

RCA® The Most Trusted Name in Electronics

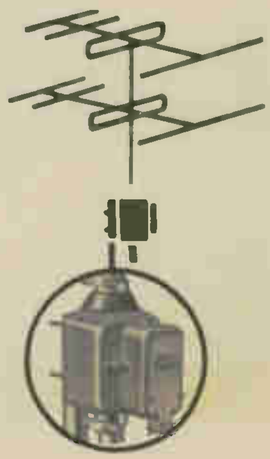
TEAR

the NEW Alliance Tenna-Rotor®

TV's better color getter...

The new C-225 Alliance Tenna-Rotor is completely transistorized featuring a patented phase-sensing bridge circuit designed from scientific laboratory test equipment, now available to afford the discriminating color TV and FM stereo owner the ultimate in reception providing:

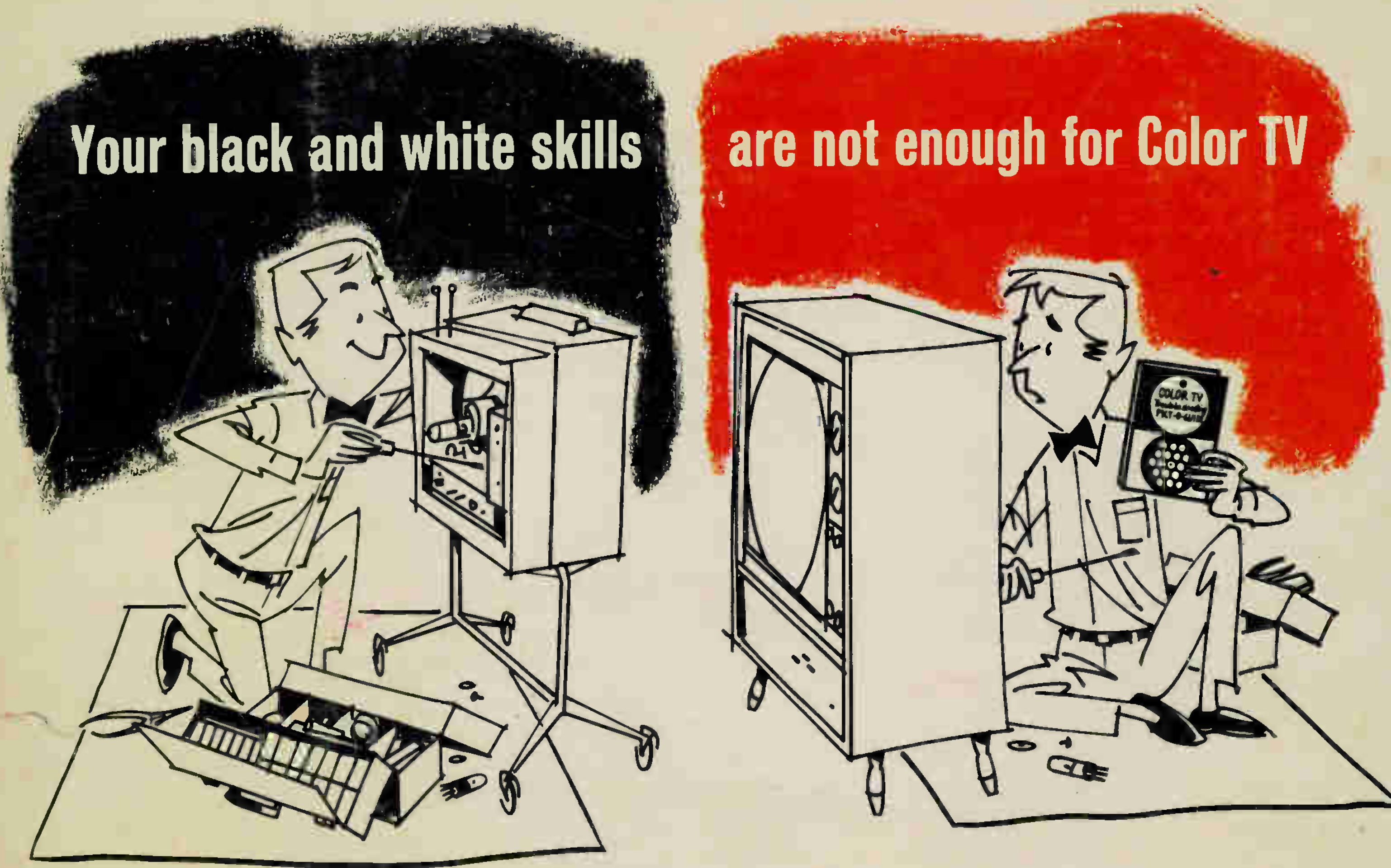
- silent operation
- accurate repeatability
- constant synchronization
- greater sensitivity
- longer life and dependability



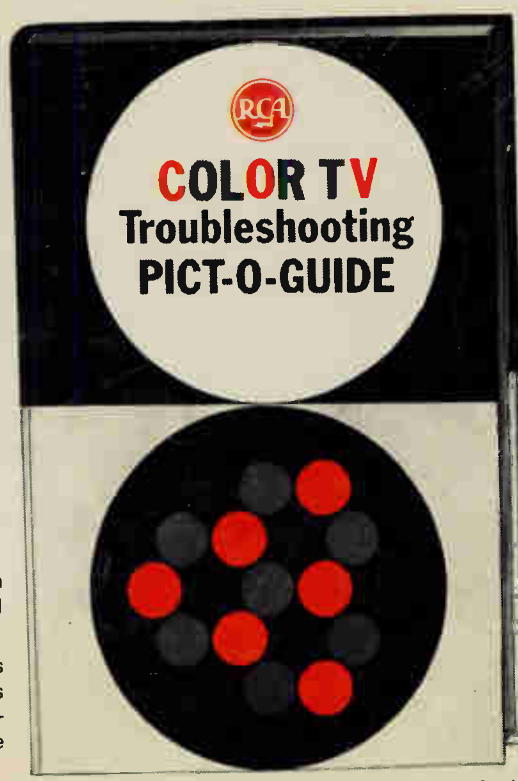
See it now! Sell it now! It means added sales and profits to you. The C-225 is the biggest advance in antenna rotation in 10 years; and, of course it's from the world's leading manufacturer of antenna rotating devices.

Complete promotional materials are available. For further details write today to:

Alliance Manufacturing Co., Inc., Alliance, Ohio
(Subsidiary of Consolidated Electronic Industries Corp.) Dept. 225



You need this book to help you cash in on Color TV business



(For a complete course in the principles and practices of color TV you will find the 8 lesson Color TV Home Study Course by RCA Institutes, 1A1325, invaluable.)

WHAT THE RCA COLOR TV PICT-O-GUIDE GIVES YOU:

- ☐ Color Fundamentals
- ☐ Receiver Set-Up
- ☐ Functions of the Color Set Controls
- ☐ How to Use Color Test Equipment
- ☐ Troubleshooting Color and Black and White Sections of Receiver
- ☐ Servicing and Alignment Techniques

...and much, much more. 150 pages. *This book should more than pay for itself the first time you use it.*

ORDER THROUGH YOUR LOCAL AUTHORIZED RCA TUBE DISTRIBUTOR

NEW RCA COLOR TV TROUBLESHOOTING PICT-O-GUIDE, 1A1389

You're missing more and more chances for profit if you're not in color TV service. There are 3 million color sets in use now . . . and the total should be at least 5 million by the end of the year.

The new, completely revised RCA Color TV Pict-O-Guide, with its many color photos and illustrated step-by-step instructions makes it possible for you to recognize and understand the visible symptoms of troubles and maladjustments in color receivers. Use the Pict-O-Guide whenever you work on a color set.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.

RCA® **The Most Trusted Name in Electronics**