OCTOBER, 1969 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing

Formerly PF Reporter

Troubleshooting TV with the scope, page 10

RF TUNER

IF AMPLIFIER

VIDEO DETECTOR

VIDEO AMPLIFIER

SYNC CIRCUITS

AGC

ATC comes to color TV, page 26

NATESA convention highlights, page 42

Put your parts in order.

All it takes is genius to arrive at simplicity. This new display stand is deceiving. It's more than a display stand. It's set up to operate like a store within your store for instant servicing.

Here, within this unit, is a complete stock of all the wide range twist prongs you'll need plus micas, miniature electrolytics, ceramics, wide range tubulars and dipped paper Mylar.* The selection was based on an extensive study of all capacitors used in the replacement market. Now, with the Re-Place, you're in the capacitor replacement business. The Re-Place only takes 2′ x 5′ in space and you have all your parts in order.

Interested? Write for our new catalog on The Re-Place™ capacitor line. "The Replacers" —the most complete line of replacement capacitors in the smallest possible package.

CDE CORNELL-DUBILIER

Circle 1 on literature card

*Du Pont Trademark

October, 1969 • Volume 19, No. 10

Electronic Servicing

Formerly PF Reporter

in this issue...

10 Troubleshooting TV with the Scope. A review of key test points, waveforms, probes, input signal requirements and general techniques that will enable you to make more effective use of your scope. **by Robert G. Middleton.**

26 Automatic Tint Control Comes to Color TV. An in-depth analysis of the operation of Magnavox's new circuitry that is designed to maintain accurate flesh tones on the screens of their "Total Automatic Color" receivers. **by Carl Babcoke.**

42 NATESA Convention Report. Highlights of the National Alliance of Television and Electronic Service Associations' annual convention in Chicago. **by Wendall Burns.**

51 Dale's Service Bench—Marine SSB Made Simple. Allan Dale explains single sideband.

56 Horizontal Sync Simplified. A practical discussion of the theory of operation and troubleshooting of the horizontal sync section, from separator to oscillator. **by Bruce Anderson.**

62 Single- and Double-Ended Audio in Auto Radio. First of a continuing series of articles that examine the circuitry of today's auto radio and relate how design changes affect servicing techniques. **by Wayne Lemons.**

DEPARTMENTS

Electronic Scanner	4	Troubleshooter	65
Letters to the Editor	8	Book Review	68
Symcure	38	Product Report	69
Test Equipment Report	46	Catalog & Literature	73
Antenna Systems Report	48	Advertisers' Index	74

Second class postage paid at Kansas City, Mo. and additional mailing offices. Published monthly by INTERTEC PUBLISHING CORP., 1014 Wyandotte St., Kansas City, Mo. 64105. Vol. 19, No. 10. Subscription rates $5 per year in U.S., its possessions and Canada; other countries $6 per year.

ABP — AUDITED PAID CIRCULATION ABC

ELECTRONIC SERVICING (with which is combined PF Reporter) is published monthly by Intertec Publishing Corp., 1014 Wyandotte Street, Kansas City, Missouri 64105.

Subscription Prices: 1 year—$5.00, 2 years—$8.00, 3 years—$10.00, in the U. S. A., its possessions and Canada.

All other foreign countries: 1 year—$6.00, 2 years—$10.00, 3 years—$13.00. Single copy 75¢; back copies $1.

Robert E. Hertel, Publisher
Intertec Publishing Corp.
Subsidiary of Howard W. Sams & Co., Inc.

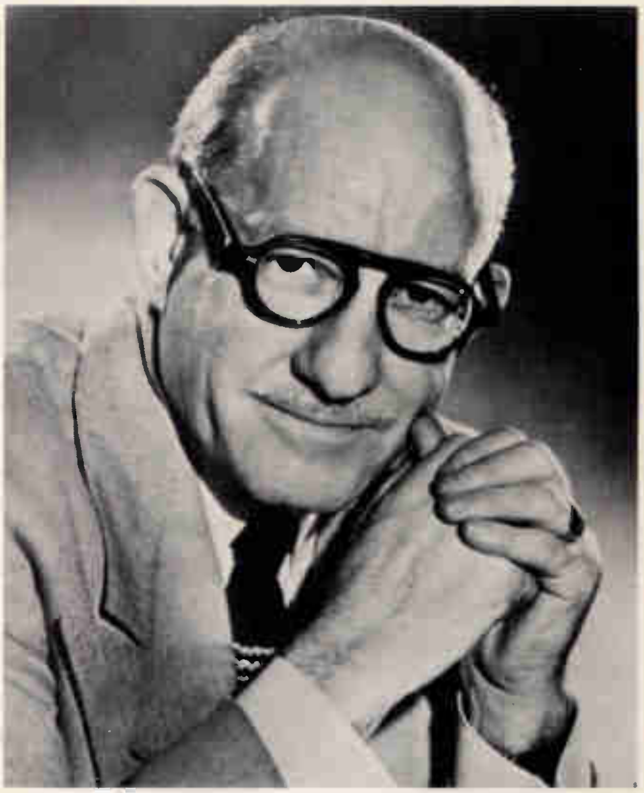
electronic scanner

news of the industry

Finneburgh Elected to NEA Electronics Hall of Fame

Morris L. Finneburgh, Sr., Board Chairman of The Finney Co., Bedford, Ohio based manufacturer of antennas, electronic components, MATV systems and accessories, has been elected to the National Electronic Associations' (NEA) Electronic Hall of Fame.

The announcement was made at the national convention of the National Electronics Association held at Waterbury, Connecticut. The honor to Mr. Finneburgh was unusually significant in that he is the first living



industrialist so recognized by the Electronics Hall of Fame which, since its establishment under the original sponsorship of NEA, has honored such persons as Thomas A. Edison, Dr. Lee Deforest, Sir John A. Fleming, Allen Dumont, Major Edwin Armstrong, Guglielmo Marconi and John P. Graham. Mr. Finneburgh was the only individual so honored for 1969.

Gorski to Head Craig Service in New Jersey

Sigmund "Sig" Gorski, veteran central service manager in the metropolitan New York area for Sears, Roebuck and Co., has been named east coast service manager for Craig Products Division of Magnosync Craig Corporation.

Marshal R. Brown, national service manager for Craig, said Gorski will headquarter at the company's new combined warehouse sales office facility at 50-52 Joseph Street, Moonachie, N.J.

The facility, first eastern branch operation for Craig, was opened in June in a move tied closely to the

OVERHAUL $9.75 • REPLACEMENT TUNERS... $10.45

Nine-seventy-five buys you a complete tuner overhaul—including parts (except tubes or transistors)—and *absolutely no hidden charges.* All makes, color or black and white. UV combos only $15.

Guaranteed means a full *12-month* warranty against defective workmanship and parts failure due to normal usage. That's 9 months to a year better than others. And it's backed up by the only tuner repair service authorized and supervised by the world's largest tuner manufacturer—Sarkes Tarzian, Inc.

Four conveniently located service centers assure speedy in-and-out service. All tuners thoroughly cleaned, inside and out . . . needed repairs made . . . all channels aligned to factory specs, then rushed back to you. They look—and perform—like new.

Prefer a universal replacement? Sarkes Tarzian will give you a universal replacement for only $10.45. This price is the same for all models. The tuner is a new tuner designed and built specifically by Sarkes Tarzian for this purpose. It has memory fine tuning—UHF plug-in for 82 channel sets—universal mounting—hi-gain—lo-noise.

ORDER TUNERS BY PART NUMBER, AS FOLLOWS:

Part #	Intermediate Frequency	AF Amp Tube	Osc. Mixer Tube	Heater
MFT-1	41.25 mc Sound 45.75 mc Video	6GK5	6LJ8	Parallel 6.3V
MFT-2	41.25 mc Sound 45.75 mc Video	3GK5	5LJ8	Series 450 MA
MFT-3	41.25 mc Sound 45.75 mc Video	2GK5	5CG8	Series 600 MA

Prefer a customized replacement tuner? The price will be $18.25. Send us the original tuner for comparison purposes, also TV make, chassis and model numbers.

SEND ORDERS FOR UNIVERSAL AND CUSTOMIZED REPLACEMENT TUNERS TO OUR OFFICE IN INDIANAPOLIS.

TSC

TUNER SERVICE CORPORATION *FACTORY-SUPERVISED TUNER SERVICE*

MIDWEST .... 817 N. PENNSYLVANIA ST., Indianapolis, Indiana .... TEL: 317-632-3493
(Home Office)
EAST .... 547-49 TONNELE AVE., Jersey City, New Jersey .... TEL: 201-792-3730
SOUTH-EAST .... 938 GORDON ST., S. W., Atlanta, Georgia .... TEL: 404-758-2232
WEST .... SARKES TARZIAN, Inc. *TUNER SERVICE DIVISION*
10654 MAGNOLIA BLVD., North Hollywood, California .... TEL: 213-769-2720

WATCH FOR NEW CENTERS UNDER DEVELOPMENT

Circle 6 on literature card

company's expanded manufacturing and marketing of electronic sound entertainment equipment. This includes Craig's recent debut in the color and black-and-white television field and introduction of a new line of car stereos, radios, and cassette and 8-track cartridge tape recorders and players.

Gorski will handle all service and parts department operations for Craig customers east of the Mississippi, including 350 of the 600 nation-wide Craig franchised warranty service centers.

Consumer Electronic Sales Up In First Half of '69

Total U.S. sales of nearly all major product categories of consumer electronic products, including domestic and foreign-label imports, showed increases during the first six months of '69 over the record-setting first six months of '68, according to a recent report from the Electronic Industries Association (EIA). The accompanying chart shows the combined sales figures for both domestic and foreign-label products for the first halves of 1968 and 1969.

Total U.S. Sales of Consumer Electronic Products—First Halves of 1968 and 1969

Category	1969	1968
Home Radio	17,197,753	13,417,014
Auto Radio	5,983,207	6,056,548
B-W TV	3,302,354	3,013,487
Color TV	2,948,785	2,560,660
Phonograph	2,687,550	2,424,330
Tape Recorders	2,752,520	2,162,926

Zenith Receives Seventh "Friend of Service" Award

Zenith Radio Corporation has been presented the "Friends of Service Management" award for the seventh consecutive year by the National Alliance of Television and Electronics Service Associations (NATESA).

Zenith is the only television manufacturer in the history of the award to receive it seven consecutive times.

The NATESA plaque was presented to Zenith for "Outstanding Service in Creating Better Customer Relations."

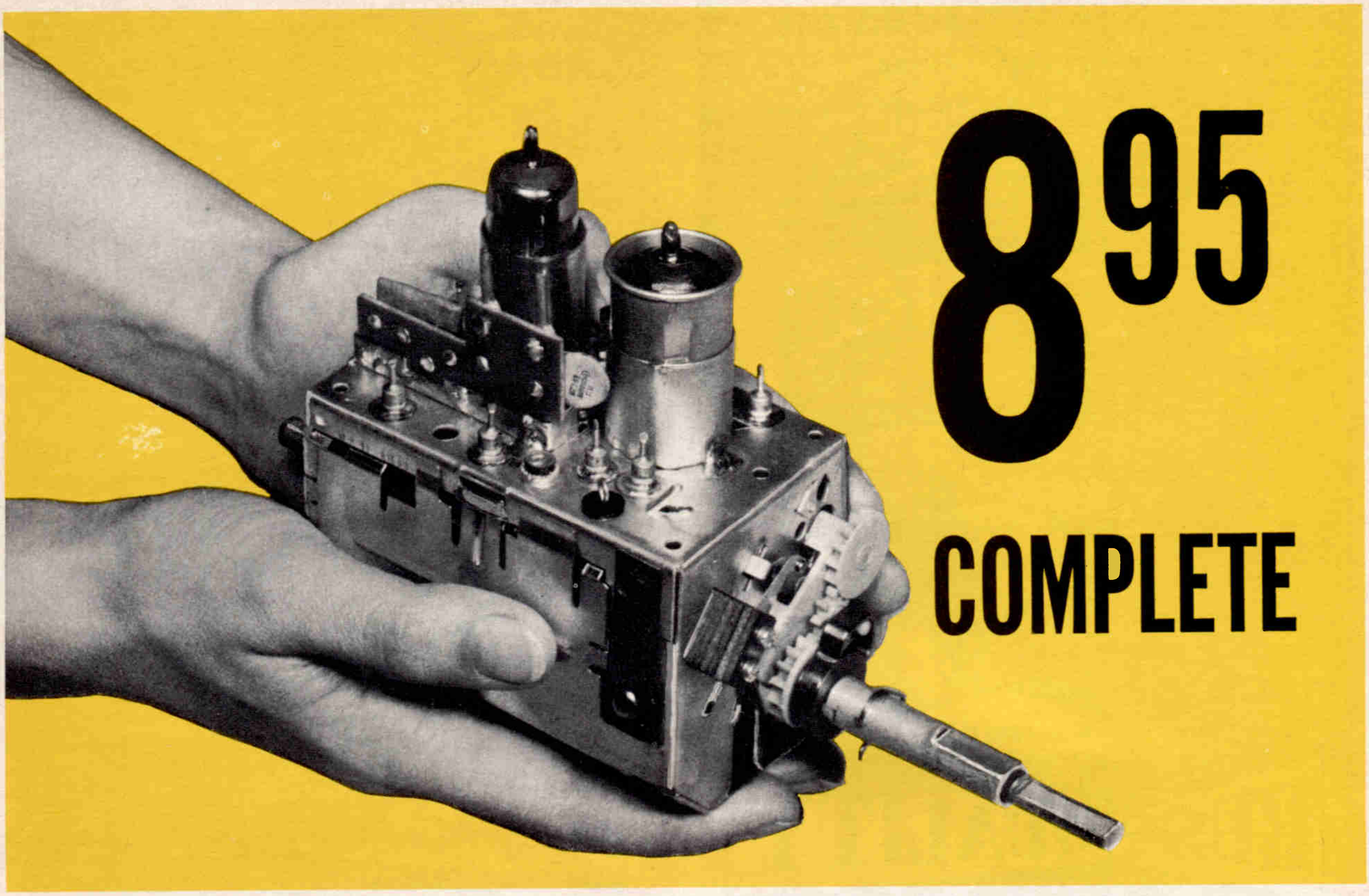
The presentation was made at the annual NATESA Convention held at the Pick-Congress Hotel in Chicago.

Brian J. Marohnic, Zenith's national service manager, accepted the award on behalf of Zenith from NATESA's executive director, Frank Mock, and Eastern vice president, Leo Shumavon.

Also present from Zenith were: Charles O'Brien, general manager of the parts and service department; Bernie Johnson and Robert Green, field engineers of the service department.

New Method of Production May Lead to Cheaper IC's

A new method of producing integrated circuits (IC's), developed by Westinghouse and licensed to Hugle Industries of Sunnyvale, California, reportedly will make possible integrated circuits up to 100 times smaller than any now in use and, equally as important, will reduce the price of IC's to one-tenth of present cost. The new process—which employs high-intensity electron beams to print circuits on silicon instead of the optical exposure system used now—reportedly can be automated, which will lead to reduced cost of IC's. ▲



Castle, the pioneer of television tuner overhauling, offers the following services to solve ALL your television tuner problems.

● OVERHAUL SERVICE — All makes and models.

VHF or UHF tuner	$9.95
UHF-VHF combination (one piece chassis)	$9.95
TRANSISTOR tuner	$9.95
COLOR tuner (Guaranteed color alignment . . . no additional charge)	$9.95

Overhaul includes parts, except tubes and transistors.

Simply send us the defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint. Your tuner will be expertly overhauled and returned promptly, performance restored, aligned to original standards and warranted for 90 days.

UV combination tuner must be single chassis type; dismantle tandem UHF and VHF tuners and send in the defective unit only.

And remember—for over a decade Castle has been the leader in this specialized field . . . your assurance of the best in TV tuner overhauling.

● CUSTOM REPLACEMENTS

Exact replacements are available for tuners that our inspection reveals are unfit for overhaul. As low as $12.95 exchange. (Replacements are new or rebuilt.)

● UNIVERSAL REPLACEMENTS

Prefer to do it yourself?

Castle universal replacement tuners are available with the following specifications.

STOCK No.	HEATERS	SHAFT Min.*	SHAFT Max.*	I.F. OUTPUT Snd.	I.F. OUTPUT Pic.	PRICE
CR6P	Parallel 6.3v	1¾″	3″	41.25	45.75	8.95
CR7S	Series 600mA	1¾″	3″	41.25	45.75	9.50
CR9S	Series 450mA	1¾″	3″	41.25	45.75	9.50
CR6XL	Parallel 6.3v	2½″	12″	41.25	45.75	10.45
CR7XL	Series 600mA	2½″	12″	41.25	45.75	11.00
CR9XL	Series 450mA	2½″	12″	41.25	45.75	11.00

*Selector shaft length measured from tuner front apron to extreme tip of shaft.

These Castle replacement tuners are all equipped with memory fine tuning, UHF position with plug input for UHF tuner, rear shaft extension and switch for remote control motor drive . . . they come complete with hardware and component kit to adapt for use in thousands of popular TV receivers.

Order universal replacements out of Main Plant (Chicago) only.

CASTLE TV TUNER SERVICE, INC.

MAIN PLANT: 5701 N. Western Ave., Chicago, Illinois 60645
EAST: 41-90 Vernon Blvd., Long Island City, N.Y. 11101

Circle 9 on literature card

letters to the editor

More Atwater Kent Info

In the January, 1969 issue of ELECTRONIC SERVICING, Mr. Sam McCrea asked for information on Atwater Kent Radios. I have a 1926-1938 radio diagrams servicing manual which has several diagrams of Atwater Kent radios that may be of help.

Being in the motel business, I only service my own TV and do not have as much time as I would like to work with electronic equipment. However, I still enjoy reading ELECTRONIC SERVICING magazine.

William L. Price
Muskegon, Michigan

Splicing Twin Lead

I do not agree with one illustration in your article titled "TV Antenna System or Receiver Defect?" in the June 1969 issue of ELECTRONIC SERVICING. On page 26, Figure 15B shows how to splice flat twin lead.

I find that the best way is to stagger the splice an inch or so, twist each lead and wrap it around itself for each twist, and then tape. This keeps the wire from untwisting. The ends cannot touch because they are spaced. I also split each wire, and first tape each wire separately and then tape both wires together.

Floyd Erickson
Taopi, Minn.

Info Needed for Japanese TV and Antique Radios

I have in the shop a Japanese 8-inch TV set, Model 8T61A, and need a schematic and service data, including a list of any parts suppliers. The only information we have so far is that it was distributed through the American Merchantile Co. of Seattle, Washington. However, they are not listed in the Seattle phone directory.

I also am interested in purchasing Rider manuals. One of our shop's chief activities is overhauling, rebuilding and refinishing antique radios dating back to the 1920's. We have Riders manuals through number 16 and would be interested in purchasing either the rest of them with an index volume or a complete set, if reasonable.

We also have various test instruments for sale which have been used five or six times.

Thank you or any readers who can help.

Burnie Watkins
147 S. E. Freeman Drive
Corvallis, Oregon 97330

The American Merchantile Co. is not included in

I am in need of a manual and schematic diagram for the Genometer generator Model TV50A. This generator was made by the Superior Instruments Company of New York; however, I don't have their full address.

I hope that one of your readers can furnish me with either the address or the schematic and manual.

Joseph H. Lakritz
650 W. 21 Street
Los Angeles, Calif. 90007

Schematic Needed for Wilcox-Gay Recorder

I am in need of a schematic diagram of a Model 5B1348 Wilcox-Gay tape recorder (chassis 28) manufactured by Recordio Corp., Charlotte, Michigan. PHOTOFACT Index does not include the address of Wilcox-Gay. The circuitry in Sams PHOTOFACT Folders 388 and 551 is similar to the Model 5B1348, but not similar enough.

Donald F. Barnes

101 Cardinal Rd.
Neptune, N. J. 07753

The manager of the PHOTOFACT Division says that Wilcox-Gay went out of business approximately 8 years ago and he does not know of any source from which can be obtained either Wilcox-Gay schematics or parts. Perhaps a fellow reader can help. ▲

our lists of distributors and importers of foreign-made television receivers. I suggest that you send all available information that you have on the TV set in question to:

Electronics Division
Japan Light Machinery
Information Center
437 Fifth Avenue
New York, New York

Perhaps they will be able to determine who the manufacturer and/or importer is and, in turn, will be able to direct you to the correct source for service information.

Radio Museum

Don't throw away your old (pre-1928) radios, parts or catalogs. I am building a free historical museum for wireless radios. We will pay any shipping costs. Please write before shipping.

Robert A. Lane
2603 Independence Avenue
Kansas City, Mo. 64124

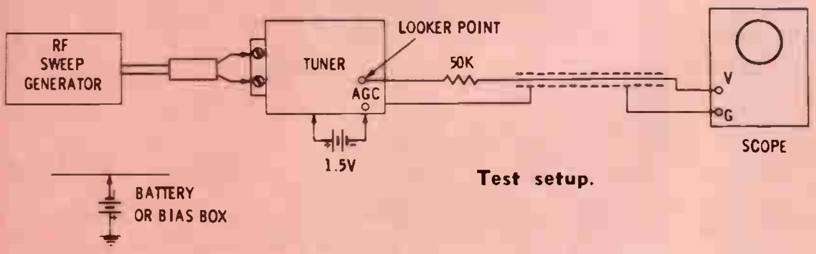
Help Needed

I am in desperate need of the frequency and voltage charts for a Jerrold transistorized TV Field strength meter Model TMT (serial number 6759).

Al Hawkes
Route 302
Highland Lake Corner
Westbrook, Maine 04092

Troubleshooting TV with the scope

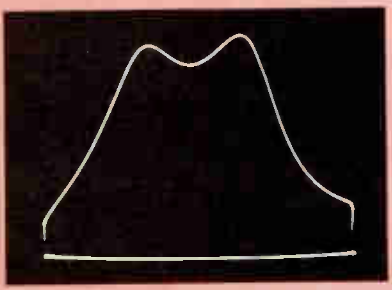
by Robert G. Middleton



Test setup.

Bias connection.

Fig. 1 Test setup for check of RF tuner response.



Typical RF response curve.

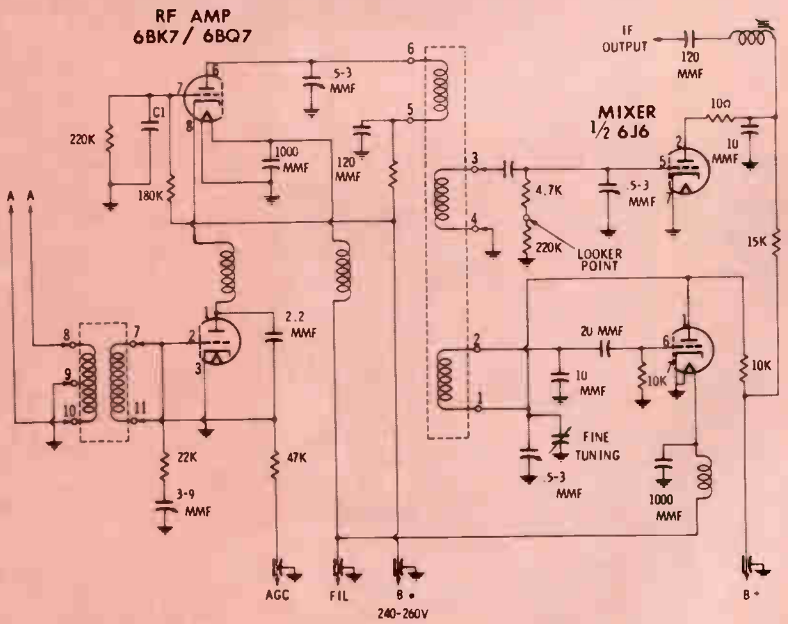


Fig. 2 Schematic diagram of typical RF tuner showing antenna input terminals AA, AGC bus, and the "looker point", and an illustration of a normal RF response curve.

A review of key test points, probe and input signal requirements, and waveforms, together with tips that will make your scope a more useful troubleshooting aid.

There are more test points and test procedures for troubleshooting TV circuits than apprentices generally suppose. Even the old-timers can occasionally benefit from a review of oscilloscope techniques. These techniques involve the following topics:

1. Scope functions and capabilities (or limitations).
2. Operation of scope controls.
3. Key test points and key waveforms.
4. Probe requirements.
5. Test-signal requirements.

Scopes can be classified into narrow-band, wide-band, and triggered-sweep types. Since the wide-band scope (with vertical-amplifier response to 4.5 MHz) is in widest use at the present time, we will assume that this type of instrument is being applied in the following tests. Inasmuch as waveform data are obtainable from each receiver section, a systematic coverage will be presented, starting with the RF tuner. Preliminary analysis is concerned with the key waveforms displayed at key test points. Follow-up tests employ supplementary test points and waveforms. Due to space limitations, our coverage will omit the intercarrier sound and audio sections, the sweep sections and chroma-circuit tests.

RF Tuners

The type of waveform processed by the RF tuner section depends upon the type of test signal that is used. A signal can be applied from a TV antenna, an RF sweep generator, or a test-pattern generator.

A sweep signal is most informative in tuner troubleshooting procedures. As shown in Fig. 1, the output from an RF sweep generator is applied to the antenna-input terminals, and a scope is connected to the tuner looker point via a resistive isolating probe. The AGC line is clamped by using a battery or bias box. Note that the 1.5-volt clamp bias indicated in Fig. 1 is a nominal value; the service data for a particular receiver might specify a higher value, such as 2.5 volts. Unless the AGC line is clamped, the scope may display a distorted response curve, due to reaction of the AGC section.

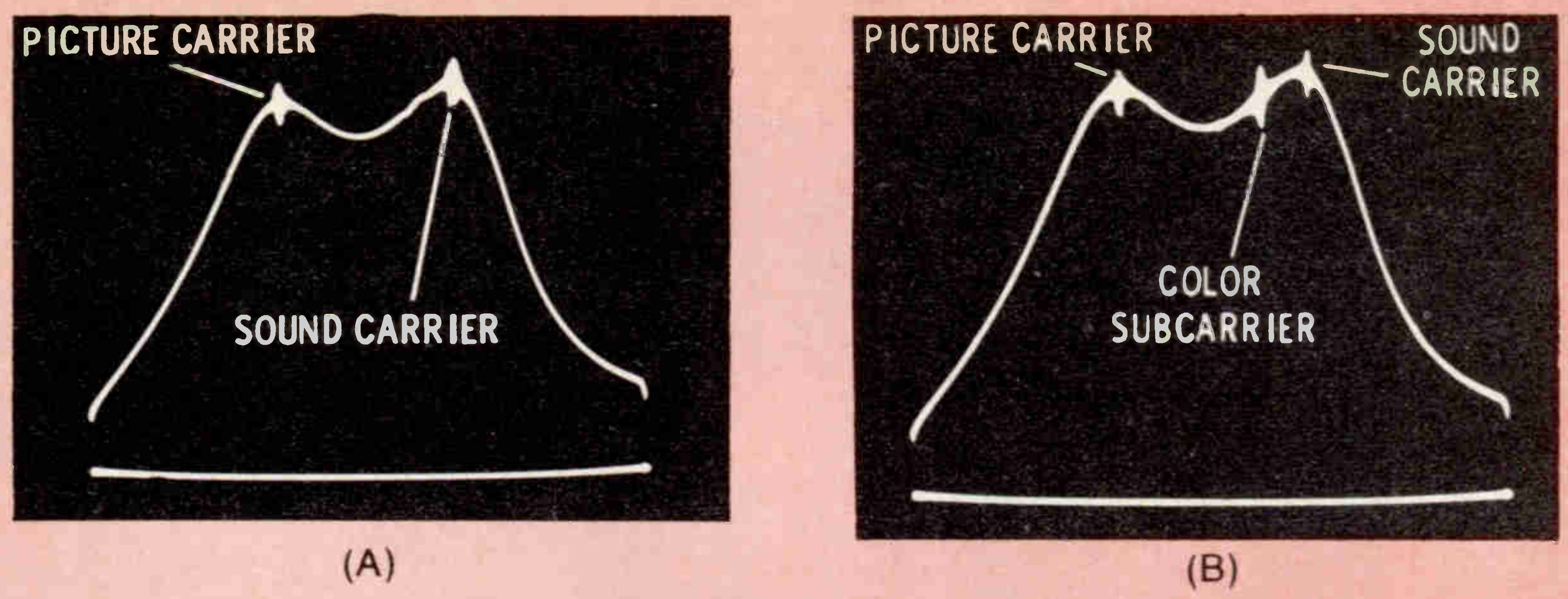


Fig. 3 (A) Curve with markers at both picture-carrier and sound-carrier points. (B) Markers at picture-carrier, color-subcarrier, and sound-carrier points on the RF response curve.

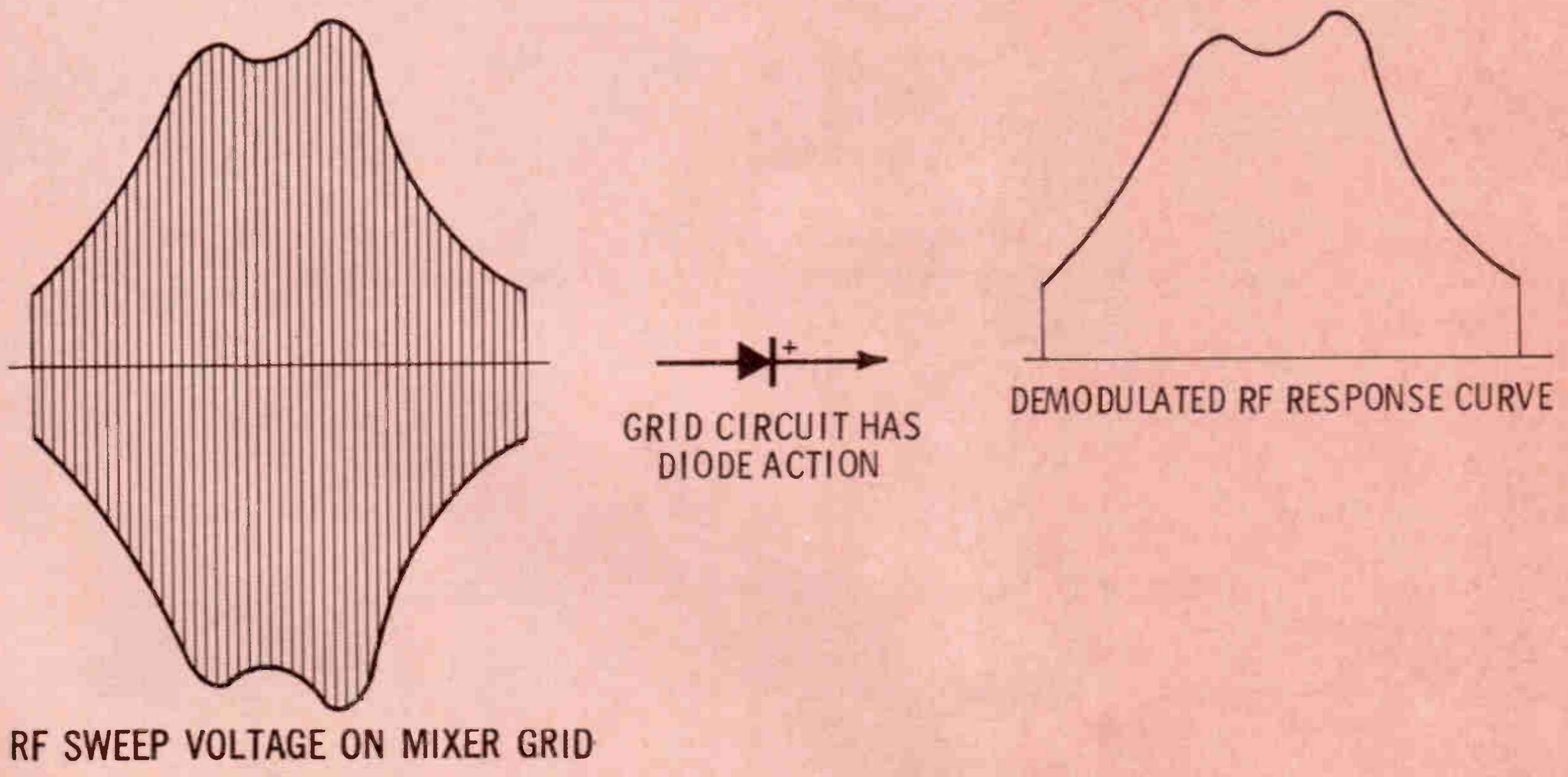


Fig. 4 Demodulator action of the mixer grid circuit.

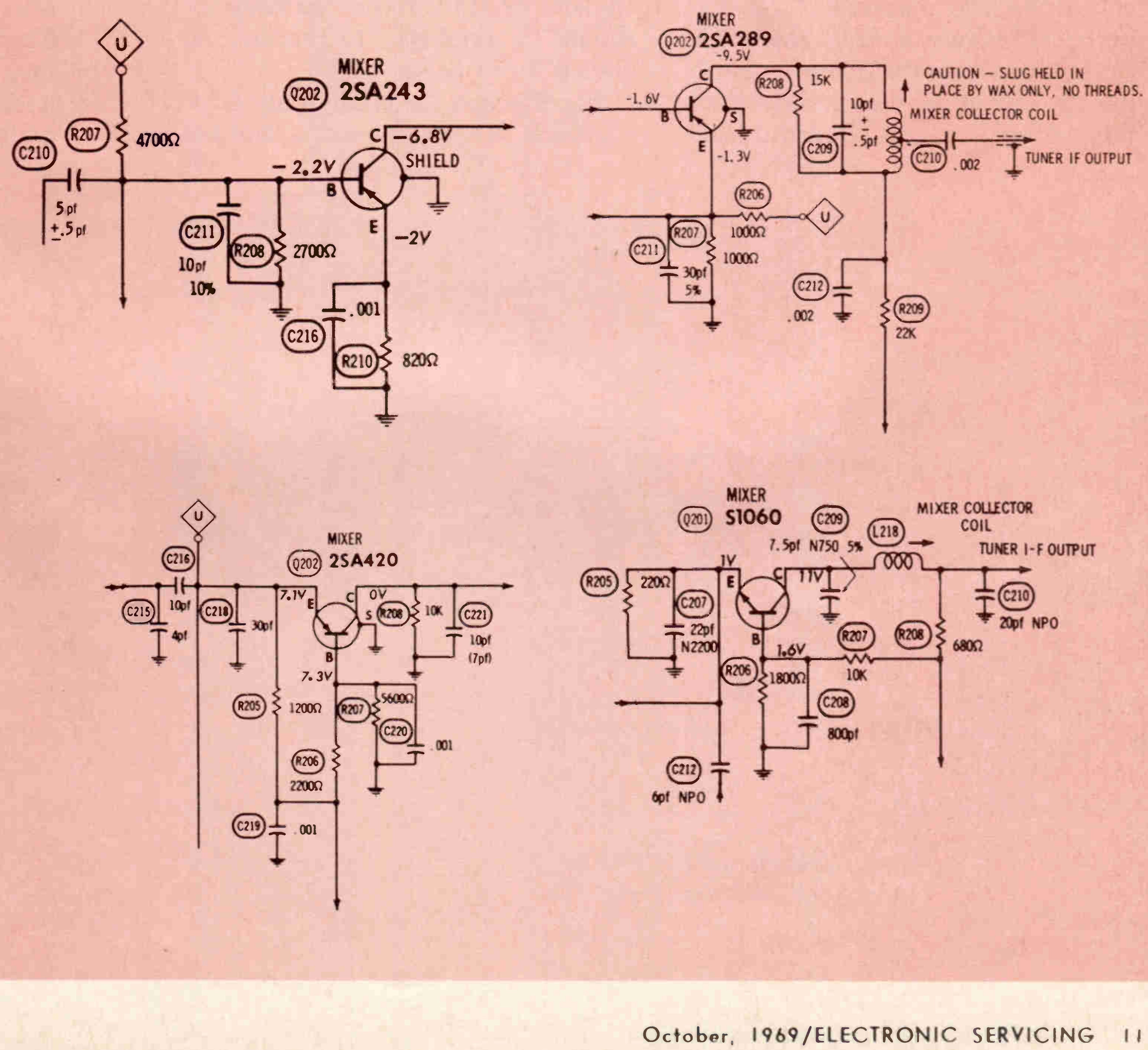


Fig. 5 Scope test points on mixers of various solid-state designs.

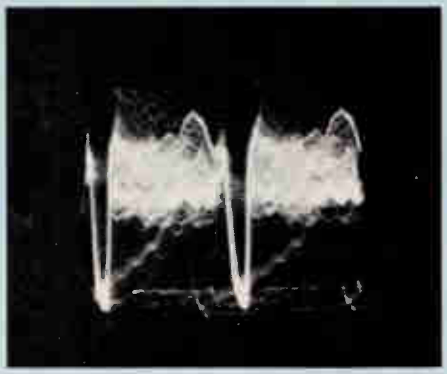


Fig. 6 Typical video-signal display at tuner looker point.

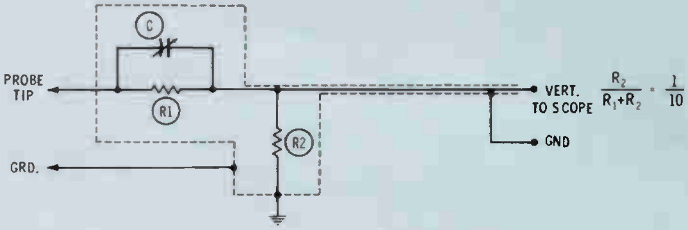


Fig. 7 Schematic diagram of low-capacitance probe.

A resistance-type isolating probe is simply a series resistor of approximately 50K ohms. It operates in combination with the capacitance of the vertical-input cable to the scope and serves two purposes. First, the probe effectively isolates the cable capacitance from the tuner circuitry, thereby avoiding disturbance of tuner-circuit action. Second, the probe provides low-pass filter action for the scope input circuit and sharpens the display of beat markers. Note that if one side of the AC line happens to be connected to the chassis, an isolation transformer should be employed to prevent the chassis from being "hot".

Fig. 2 shows the configuration for a typical RF tuner, and a normal response curve. Observe that the "looker point" is a tap on the mixer grid-leak resistance. A demodulator probe is **not** required at this key test point because the grid circuit of the mixer tube operates as a diode detector. In a preliminary signal-tracing test, you should be concerned only with the presence or absence of signal at the looker point. Note that a waveform check should be made on each channel because a tuner often develops difficulty that affects only one channel.

Assuming that the signal appears at the looker point, the chief characteristics that concern us are:

1. The gain of the RF amplifier stage. Whether or not the gain is normal can only be determined by familiarity with your sweep generator and scope. In case of doubt, connect the generator and scope to a receiver that is in good operating condition; note the instrument control settings and the height of the pattern on the scope screen. Compare these with those produced by the receiver being tested.
2. The bandwidth of the RF amplifier stage. This can only be determined accurately by the use of markers (Fig. 3). A marker generator may be built into the sweep generator, or it may be provided as a separate instrument.

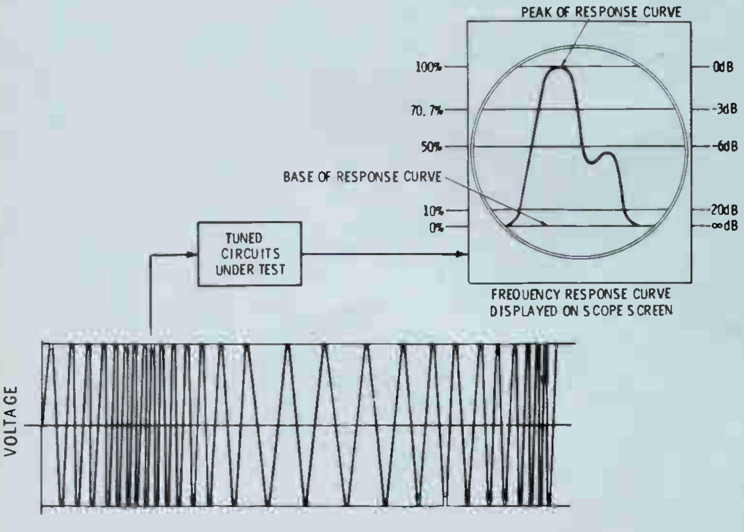
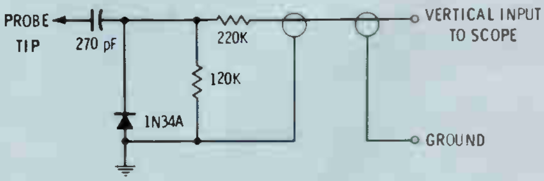


Fig. 8 FM waveform used to develop a frequency response curve.



FREQUENCY RESPONSE CHARACTERISTICS:

RF CARRIER RANGE	500 kHz to MHz
MODULATED-SIGNAL RANGE	30 to 5000 HERTZ
INPUT CAPACITANCE (APPROX.)	2.25 pF
EQUIVALENT INPUT RESISTANCE (APPROX.):	
AT 500 kHz	25,000 OHMS
1 MHz	23,000 OHMS
5 MHz	21,000 OHMS
10 MHz	18,000 OHMS
50 MHz	10,000 OHMS
100 MHz	5000 OHMS
150 MHz	4500 OHMS
200 MHz	2500 OHMS
MAXIMUM INPUT:	20 RMS VOLTS
AC VOLTAGE	28 PEAK VOLTS

Fig. 9 Demodulator probe circuit and characteristics.

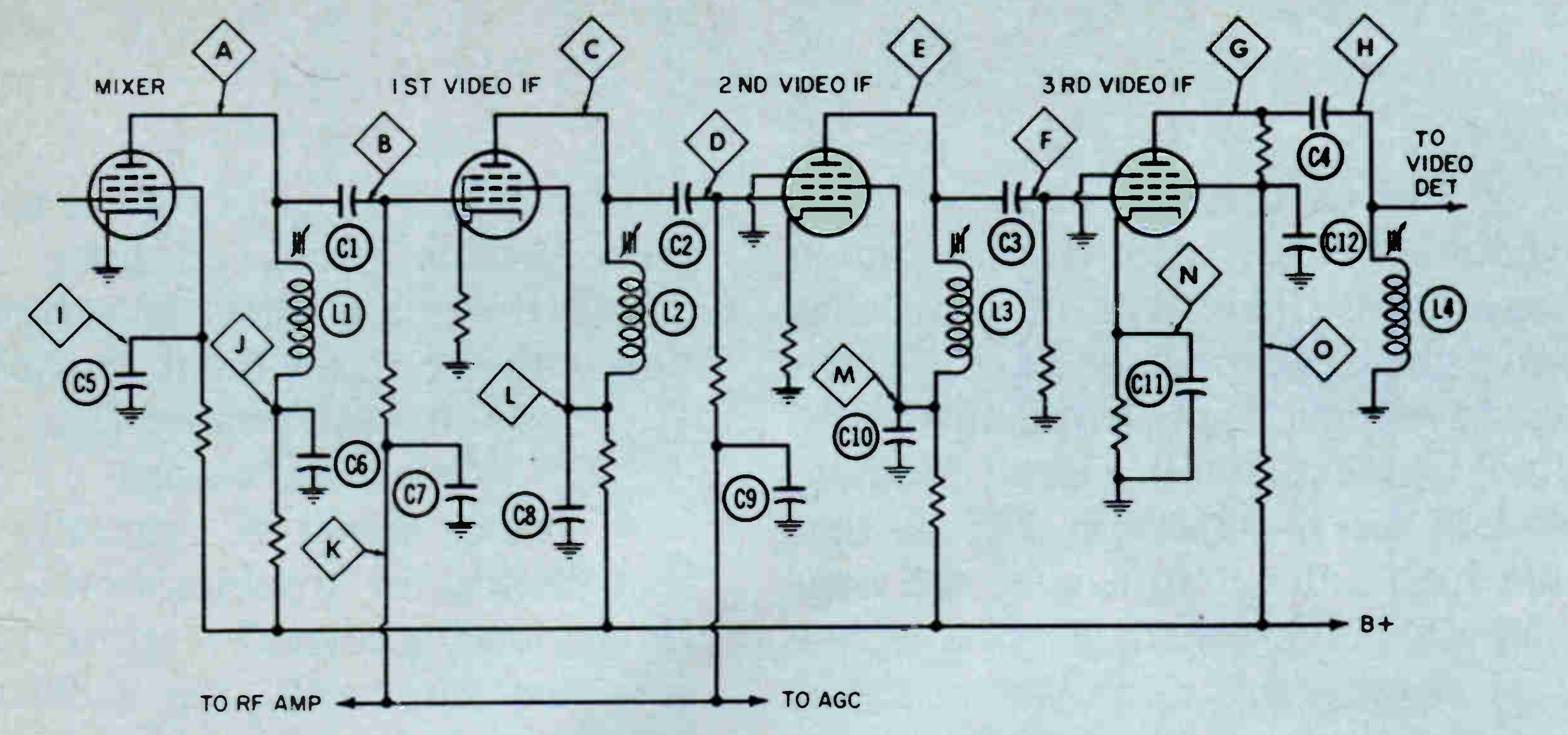


Fig. 10 A three-stage tube-type video IF amplifier section.

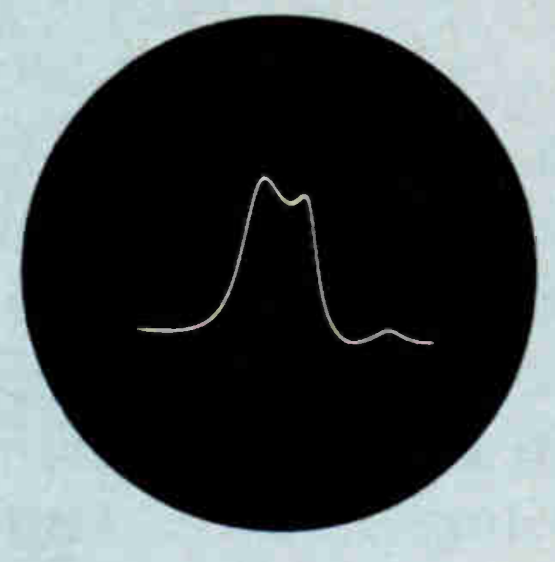


Fig. 11 Pattern produced by a sweep generator.

3. The stability of the RF amplifier stage. The operating stability is checked by reducing the AGC clamp bias and the output level from the sweep generator, and observing whether the shape of the response curve changes substantially. A large change in curve shape indicates regenerative distortion due to a circuit defect.

Fig. 4 presents an illustration of the demodulator action that occurs in the mixer-grid circuit. Note that the mixer grid operates at zero bias in Fig. 2; thus, rectification occurs when an AC signal is applied to the grid. The same principle applies to a transistorized mixer, as shown in Fig. 5.

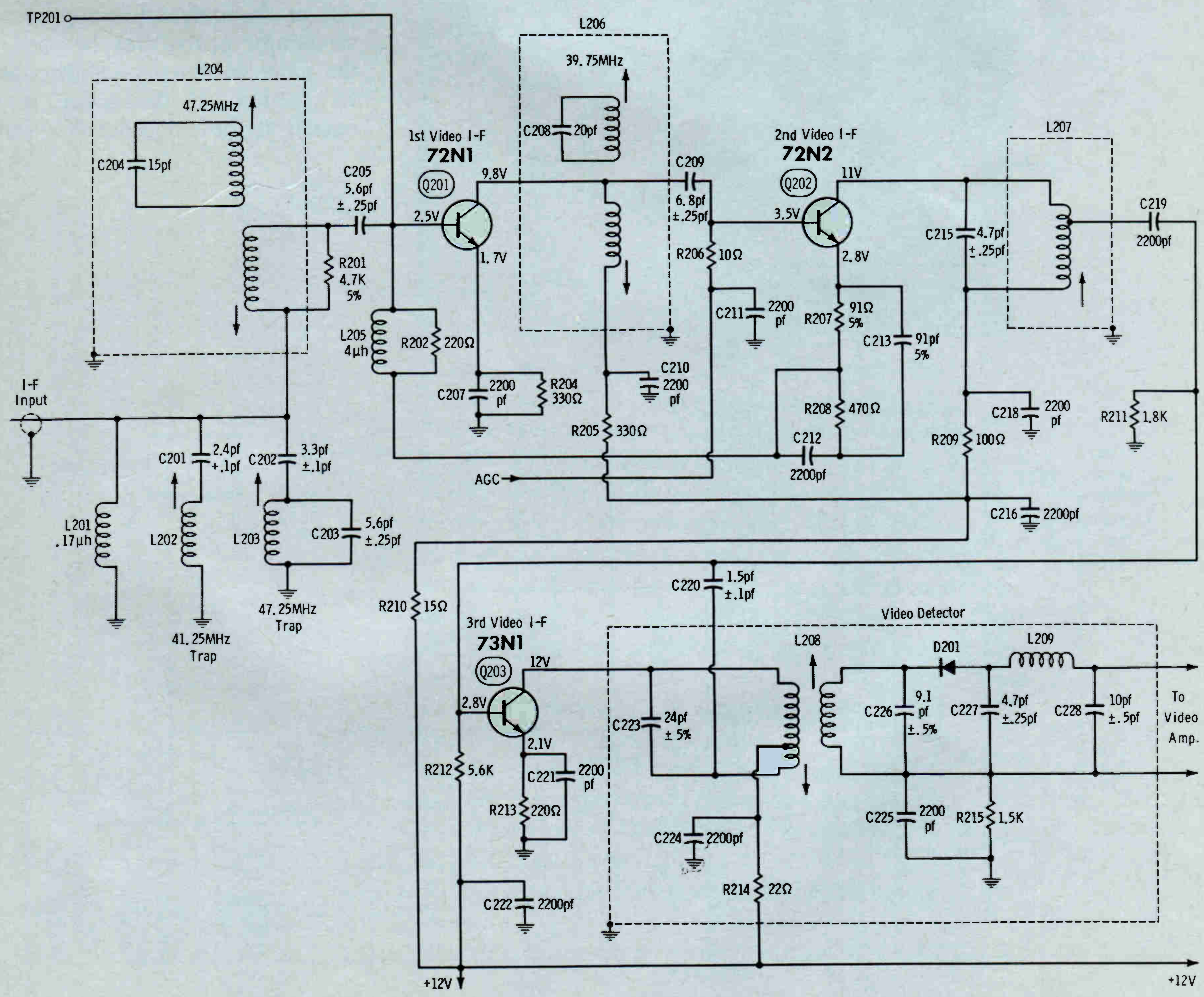


Fig. 12 A three-stage transistor IF amplifier circuit

As in the case of tube-type tuners, a looker point is usually provided in transistor mixer circuits; however, these are exceptions, as shown in Fig. 5D. In this situation, the isolating resistor must be connected to the emitter terminal of Q201.

A test-pattern generator signal may be used in simple signal-tracing tests. With a test pattern input, a video-signal display will normally be observed at the mixer grid (Fig. 6).

A low-capacitance probe (Fig. 7) should be used to display video waveforms. This type of probe has wide-band response and a sufficiently high-input impedance to avoid objectionable circuit loading. It can be observed in Fig. 6 that the high video frequencies are considerably attenuated in spite of the fact that a low-capacitance probe was employed. This high-frequency distortion is caused by the resistance between the looker point and the mixer grid (Fig. 2). The probe has from 5 to 10 pf of input capacitance, which forms an integrating circuit (low-pass filter) in combination with the series input resistance.

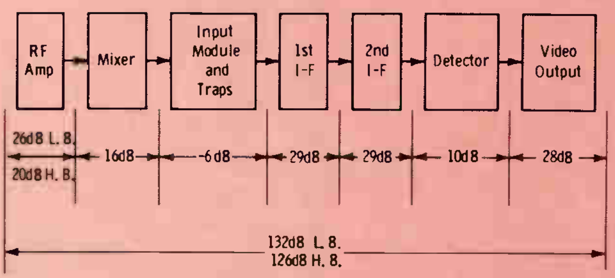


Fig. 13 Normal stage gain (in dB) for a receiver with two IF stages.

IF Amplifiers and Video Detectors

A sweep signal is generally the best choice for troubleshooting the IF section for several reasons. First, gain measurements are facilitated because a sweep signal has constant amplitude. Subnormal or abnormal bandwidth is immediately apparent. Either signal-tracing or signal-substitution procedures can be used.

The sweep signal may be applied at the antenna-input terminals of the receiver, and heterodyned (by the mixer) into the IF section (Fig. 8). Alternatively, the signal may be injected at any stage from the mixer up to the video detector. The scope may be connected at the output of the video detector or a demodulator probe may be used with the scope to signal-trace through the IF section. If the scope is connected at the video-detector output,

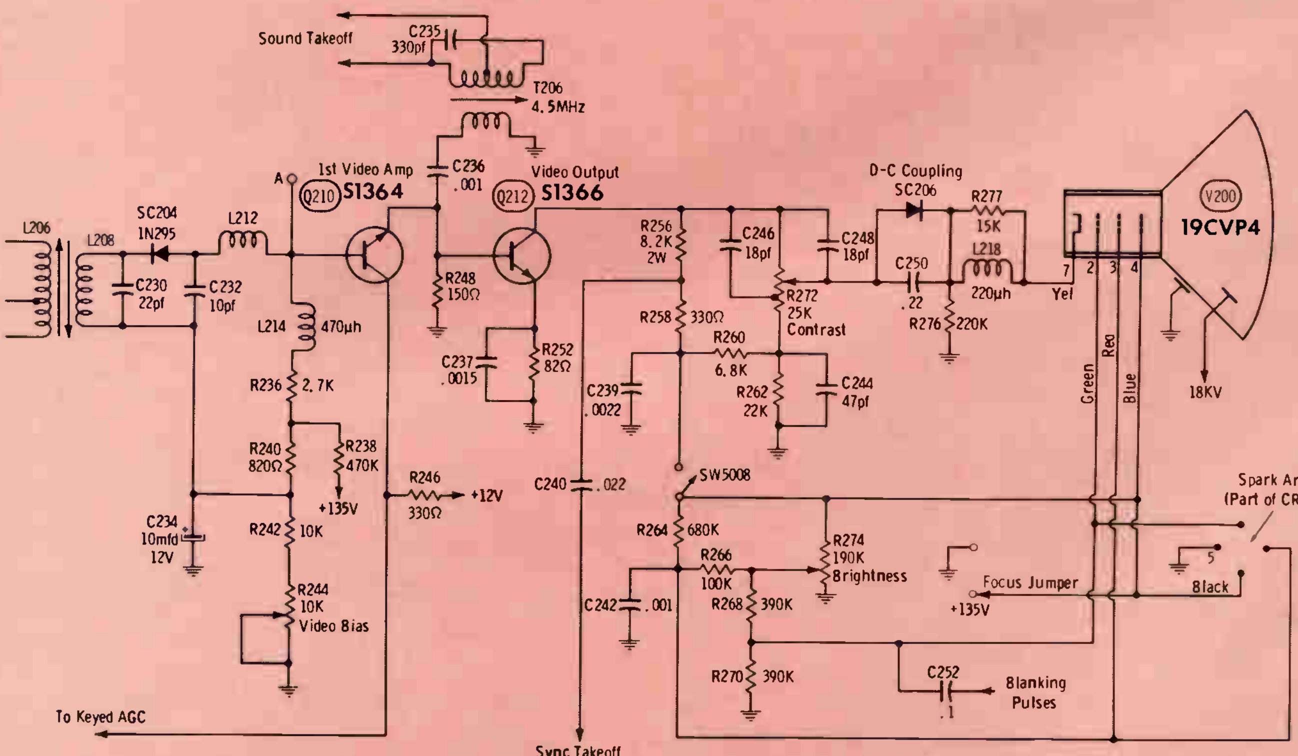
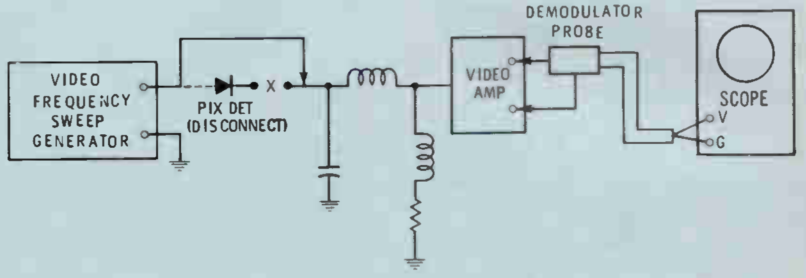


Fig. 14 A typical video amplifier configuration.

a simple resistance-type isolating probe can be employed, as depicted in Fig. 1. On the other hand, to signal-trace prior to the video detector, a demodulator probe (sometimes called a traveling detector) must be used. The circuit and characteristics of a standard demodulator probe are shown in Fig. 9.

Next, let us consider the basic tests that are made in an IF amplifier (Fig. 10). The lowest signal level occurs in normal operation at point A and the highest at point H. If C1 were open, however, this relation would be reversed. The normal signal level at E will be greater than at D, though the reverse sometimes appears to be the case in signal-tracing tests. This reversal can occur because the input capacitance of the probe (Fig. 9) tends to detune an IF circuit. Most IF amplifiers are stagger-tuned. In case L3



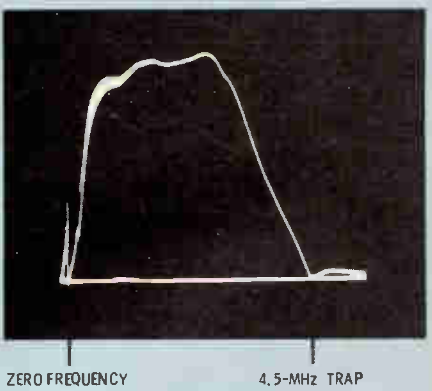


Fig. 15 (A) Test setup for checking response of video amplifier (B) Normal video-amplifier response curve.

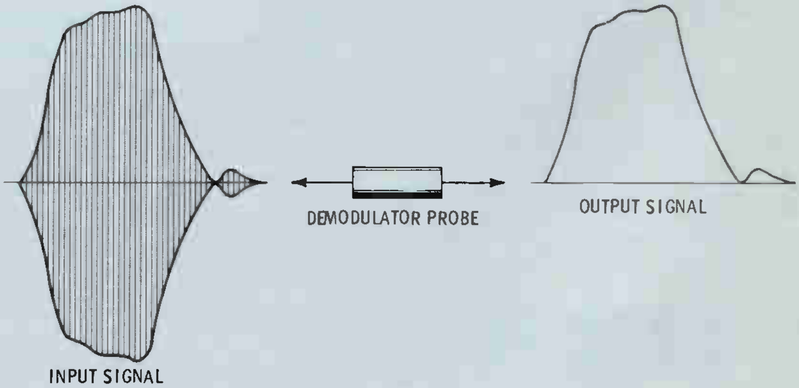


Fig. 16 Action of a demodulator probe.

How to get into one of today's hottest money-making fields—*servicing 2-way radios!*

More than 5 million two-way transmitters have skyrocketed the demand for service men and field, system, and R & D engineers. Topnotch licensed experts can earn $12,000 a year or more. You can be your own boss, build your own company. And you don't need a college education to break in.

HOW WOULD YOU LIKE to earn $5 to $7 an hour... $200 to $300 a week ... $10,000 to $15,000 a year? One of your best chances today, especially if you don't have a college education, is in the field of two-way radio.

Two-way radio is booming. Today there are more than *five million* two-way transmitters for police cars, fire trucks, taxis, planes, etc. and Citizen's Band uses—and the number is growing at the rate of 80,000 per month.

This wildfire boom presents a solid gold opportunity for trained two-way radio service experts. Most of them are earning between $5,000 and $10,000 a year *more* than the average radio-TV repair man.

Why You'll Earn Top Pay

The reason is that the U.S. doesn't permit anyone to service two-way radio systems unless he is *licensed* by the FCC (Federal Communications Commission). And there aren't enough licensed experts to go around.

This means that the available licensed expert can "write his own ticket" when it comes to earnings. Some work by the hour and usually charge at least $5.00 per hour, $7.50 on evenings and Sundays, plus travel expenses. Others charge each customer a monthly retainer fee, such as $20 a month for a base station and $7.50 for each mobile station. A survey showed that one man can easily maintain at least 15 base stations and 85 mobiles. This would add up to at least $12,000 a year.

How to Get Started

How do you break into the ranks of the big-money earners in two-way radio? This is probably the best way:

1. Without quitting your present job, learn enough about electronics fundamentals to pass the Government FCC License. Then get a job in a two-way radio service shop and "learn the ropes" of the business.

2. As soon as you've earned a reputation as an expert, there are several ways you can go. You can move out, and start signing up your own customers. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you $5,000. Or you may be invited to move *up* into a high-prestige salaried job with one of the same manufacturers.

The first step—mastering the fundamentals of Electronics in your spare time and getting your FCC License—can be easier than you think.

Cleveland Institute of Electronics has been successfully teaching Electronics by mail for over thirty years. Right at home, in your spare time, you learn Electronics step by step. Our AUTO-PROGRAMMED® lessons and coaching by expert instructors make everything clear and easy, even for men who thought they were "poor learners."

Your FCC License... or Your Money Back!

By the time you've finished your CIE course, you'll be able to pass the FCC License Exam with ease. Better than nine out of ten CIE graduates are able to pass the FCC Exam, even though two out of three non-CIE men fail. This startling record of achievement makes possible our famous FCC License Warranty: you'll pass the FCC Exam upon completion of your course or your tuition will be refunded in full.

Find out more. Mail the bound-in post-paid card for two FREE books, "How To Succeed In Electronics" and "How To Get A Commercial FCC License." If card has been detached, use coupon below.

ENROLL UNDER NEW G.I. BILL

All CIE courses are available under the new G.I. Bill. If you served on active duty since January 31, 1955, or are in service now, check box on card for G.I. Bill information.

CIE Cleveland Institute of Electronics
1776 East 17th Street, Cleveland, Ohio 44114

Please send me without cost or obligation:

1. Your 44-page book "How To Succeed In Electronics" describing the job opportunities in Electronics today, and how your courses can prepare me for them.

2. Your book on "How To Get A Commercial FCC License."

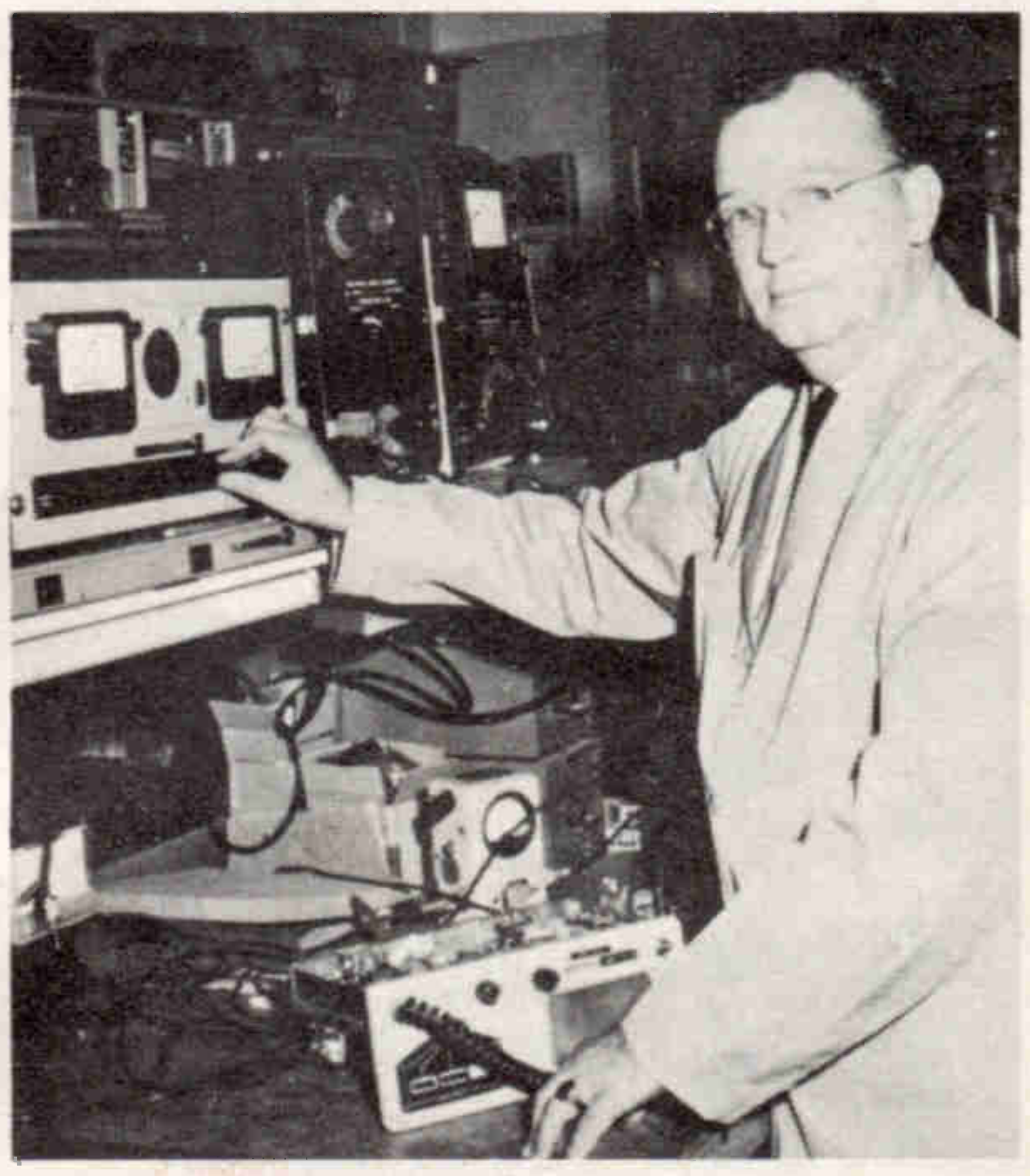
Name ________________ Age ______
(PLEASE PRINT)

Address ________________

City ____________ State ________ Zip ______

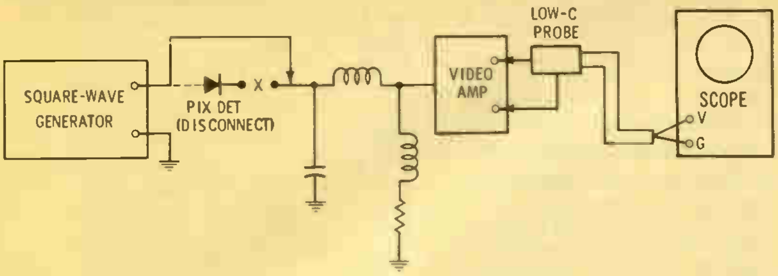
Accredited Member National Home Study Council **PF-60**

He's flying high. *Before he got his CIE training and FCC License, Ed Dulaney's only professional skill was as a commercial pilot engaged in crop dusting. Today he has his own two-way radio company, with seven full-time employees. "I am much better off financially, and really enjoy my work," he says. "I found my electronics lessons thorough and easy to understand. The CIE course was the best investment I ever made."*

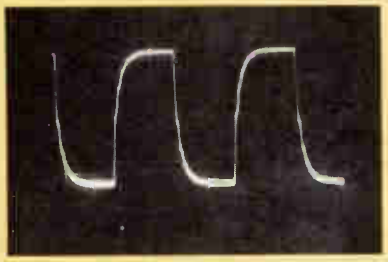


Business is booming. *August Gibbemeyer was in radio-TV repair work before studying with CIE. Now, he says, "we are in the marine and two-way radio business. Our trade has grown by leaps and bounds."*

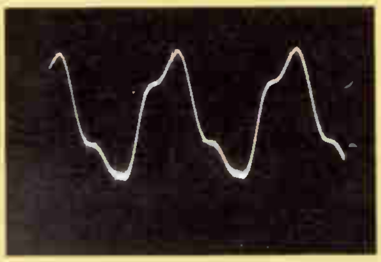
Circle 13 on literature card



(A) Test setup.



(B) 100-kHz waveform.



(C) 1-MHz waveform.

Fig. 17 Test setup for checking the square-wave response of a video amplifier, and resultant responses.

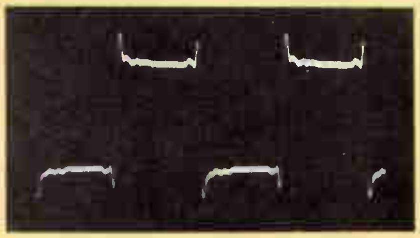
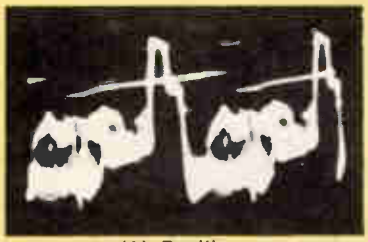
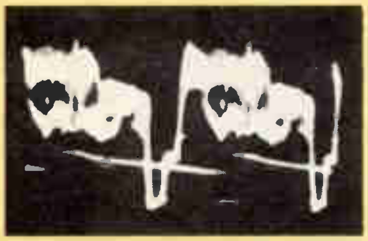


Fig. 18 Normal 100-KHz square-wave response of a high-performance video amplifier.



(A) Positive



(B) Negative

Fig. 19 Positive- and negative-going video signals.

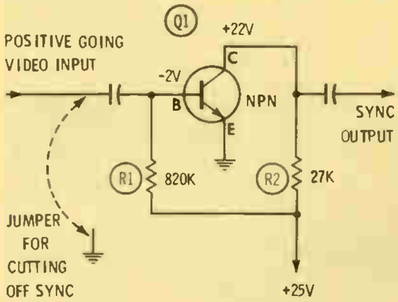


Fig. 20 Sync separator circuit using class-C bias.

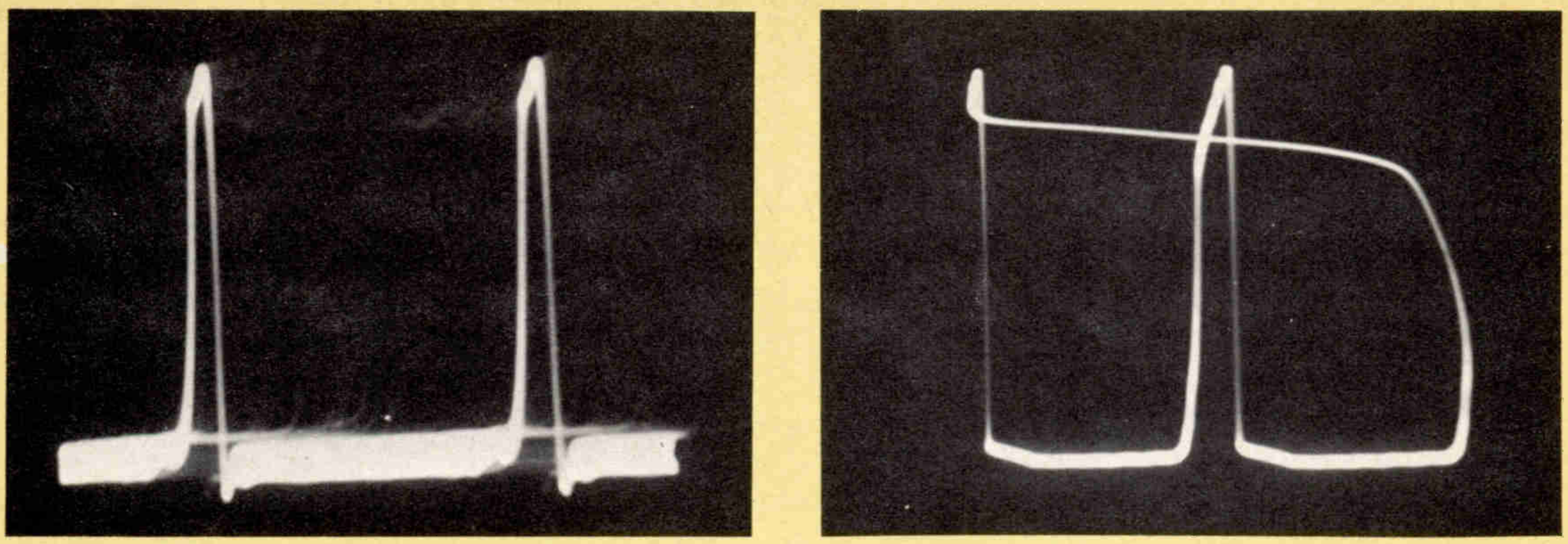
is tuned to a lower frequency than L2, application of the probe to point E lowers the resonant frequency of L3. In turn, the impedance of the L3 plate-load circuit becomes abnormally low, and the stage may appear to have a loss instead of a gain. Therefore, signal-tracing tests are concerned chiefly with the presence or absence of signal. Although somewhat different patterns will be observed at each stage, Fig. 11 is typical.

In the case of a transistor IF strip (Fig. 12) less detuning is imposed by a demodulator probe than when signal-tracing a tube-type IF amplifier. That is, the comparatively large junction capacitance of a transistor makes the input capacitance of the probe a smaller fraction of the total circuit capacitance.

Signal-tracing procedures are a practical method of pinpointing open capacitors, which often produce no change in DC voltage distribution. For example, if C2 in Fig. 10 should become open, a signal will be found at its left-hand terminal, but no signal will appear at its right-hand terminal. Again, let us consider C8; test point L is normally "cold," but if the capacitor is open, we will find signal present at test point L.

Quantitative checks of IF stages involve gain measurements, and these are made to best advantage by signal-injection techniques. Connect the scope through an isolating resistor to the output of the video detector. Then, an IF sweep signal is applied at successive grids (or at successive bases in a transistor circuit). Stage gains are measured by the difference in pattern heights (Fig. 8). For example, suppose that we measure –20 dB when the signal is injected at the video-detector input, and measure 0 dB when the same signal is injected at the grid of the last IF stage. Then, the gain of the last IF stage is evidently 20 dB. Fig. 13 shows the stage gains in a typical two-IF receiver. There are a few practical points to be kept in mind:

1. A blocking capacitor should be connected in series with the "hot" output lead from the sweep generator to avoid grid-bias (or base-bias) drain-off.
2. The IF AGC line should be clamped at the bias value specified in the receiver service



(A) (B)

Fig. 21 A two-stage sync separator removes the residual video signal shown in A, producing the "cleaned-up" signal in B.

data to avoid erratic response due to AGC fluctuation.

3. If the step attenuator on the scope is switched to 10 times greater gain, subtract 20 dB from the value indicated by the pattern height on the scope screen. Conversely, if the scope is switched to 1/10 gain, add 20 dB to the value indicated by the pattern height.

Video Amplifier Tests

Video-amplifier tests can be categorized into sweep-frequency and square-wave tests, insofar as scope application is concerned. A typical video-amplifier configuration is shown in Fig. 14. The video-detector diode (SC204) should not be confused with the SC206 DC coupling diode; that is, the SC204 operates as a demodulator, whereas diode SC206 maximizes the amplitude linearity of the video-amplifier system. Let us consider a frequency-response test of a video amplifier.

The output from a video-frequency sweep generator is applied at the input of the video amplifier, as depicted in Fig. 15A. It is good practice to temporarily disconnect the picture-detector diode to avoid possible distortion of the input signal. A demodulator probe (Fig. 9) is connected from the output of the video amplifier to the vertical-input terminals of the scope. This provides a demodulated response curve (Fig. 15B). The action of a demodulator probe is depicted in Fig. 16. Thus, if we use a low-capacitance probe (Fig. 7) in place of the demodulator probe in Fig. 15A, the scope will then display the **input signal** shown in Fig. 16. Note that a wide-band scope with full response up to 4.5 MHz must be used to display the input waveform, although a narrow-band scope is adequate to display the output waveform depicted in Fig. 16.

A square-wave check of a video amplifier is made as shown in Fig.

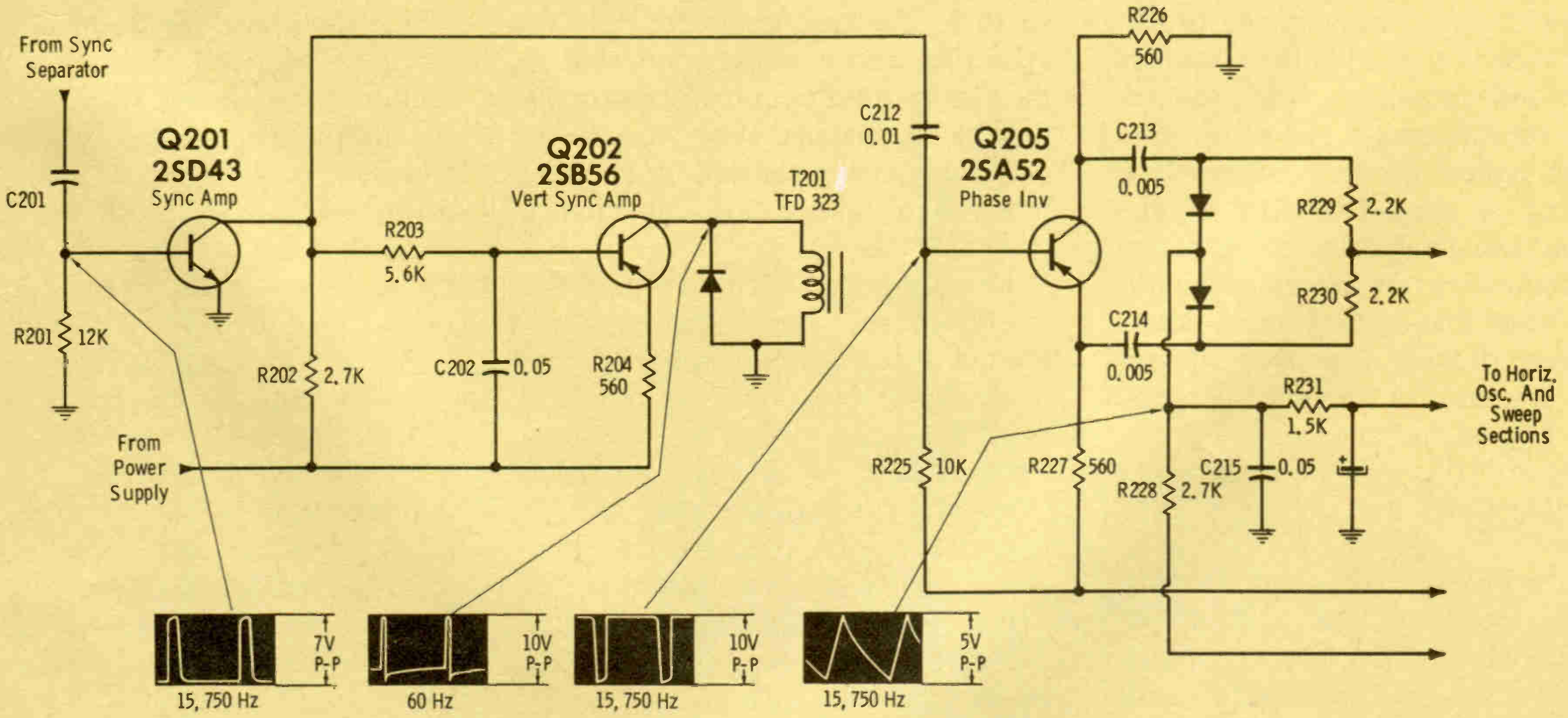
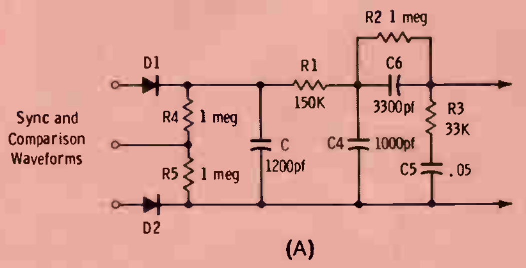


Fig. 22 A sync section that employs a separate transistor as a vertical-sync amplifier.

Fig. 23 Peak voltages change when the phase of the comparison waveform changes.

A. Basic AFC circuit.

B. Waveforms.



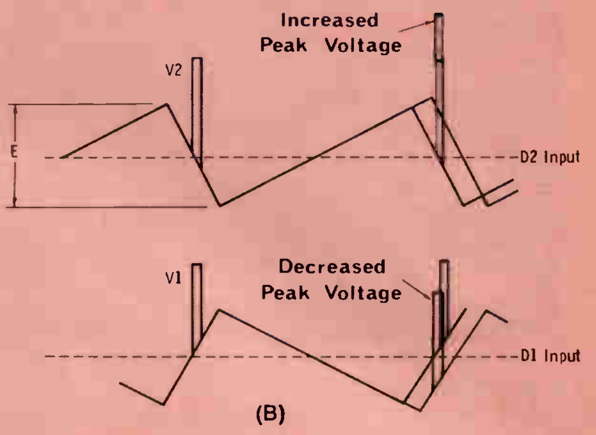
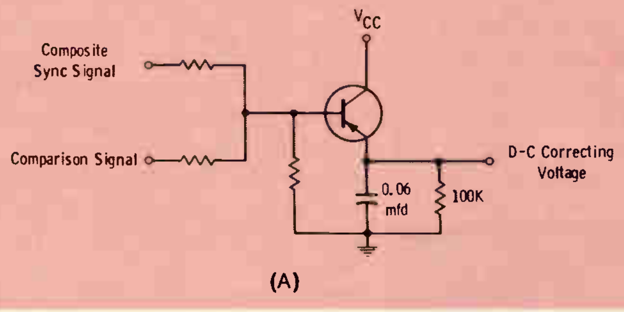
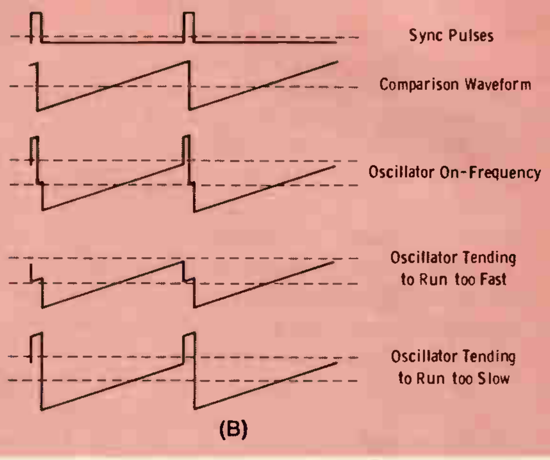


Fig. 24 A pulse-width AFC arrangement.

A. Circuit diagram.

B. Waveforms





17. As before, it is good practice to temporarily disconnect the video-detector diode to avoid possible distortion of the input signal. A wide-band scope is required, and must be used with a low-capacitance probe. The probe is applied at the output of the video amplifier. The square-wave reproductions shown in Fig. 17 are typical for an economy-type receiver. A greater amount of distortion usually points to a defective component in the video amplifier. Note that deluxe (and color) receivers provide improved square-wave response in normal operation (Fig. 18). Manufacturers often permit up to 10% overshoot in order to obtain faster rise.

Sync Waveforms and Tests

Sync waveforms are checked with a video signal present. A test-pattern generator is preferred because its output is controlled.

Beginning technicians are sometimes confused by "positive-going" and "negative-going" sync waveforms; the distinction is illustrated in Fig. 19. The sync separator (Fig. 20) requires a positive-going sync waveform. In normal operation, a signal-developed bias of –2 volts is produced between base and emitter. In turn, the base conducts only on sync tips, and a scope connected to the sync-output circuit will normally display a stripped-sync waveform. Although not essential, it is good practice to use a low-capacitance probe in this test.

Economy-type receivers may use a single-stage sync separator, although two stages insure that residual video signal will be removed over the entire range of incoming signal levels in normal operation (Fig. 21). Also, tighter sync lock is provided under conditions of weak and/or noisy signal conditions.

Poor sync-stripping action is often caused by leaky coupling capacitors, or by collector leakage in a sync-section transistor. Useful clues for pinpointing defective components are often provided by peak-to-peak voltage measurements of the sync waveforms. The measured values are analyzed with respect to the values specified in the receiver service data (Fig. 22).

Fig. 22 depicts the comparison system of horizontal-AFC action, in which the phase (or frequency) of a sawtooth derived from the sweep section is compared with the phase (or frequency) of the sync pulses. The sync pulses (Fig. 23) ride up or down on the sawtooth waveform, depending on whether the horizontal oscillator tends to run too slow or too fast. In turn, the peak voltage of the composite waveform changes, causing the rectified output voltage to change. This change in control voltage is used to correct the frequency of the horizontal oscillator. Capacitor defects cause waveform distortion; if C6 in Fig. 26A opens, the phase relations will be changed and the sync system will "hunt", causing a pie-crust picture symptom.

Another comparison system is a pulse-width arrangement (Fig. 24), in which a phase shift between the sync pulse and the sawtooth com-

Here's where we can save you time.

Every minute is longer up there.

You can save as many as 20 or 30 of those long minutes when you put up one of our larger antennas, because they're pre-assembled. Our snap-joints take only seconds to lock in place.

Sylvania antennas are equipped with a double boom (for strength and rigidity).

All have strong, seamless, half-inch tubular elements (not rolled-over strips of aluminum).

All aluminum parts are gold-alodized inside and out (not sprayed, but dipped).

Even more care goes into the electronics.

We've peaked our antennas for flat response over the entire 6 MHz bandwidth of each TV channel. Flat response is absolutely necessary for good color reception. Otherwise, color rendition may be lost.

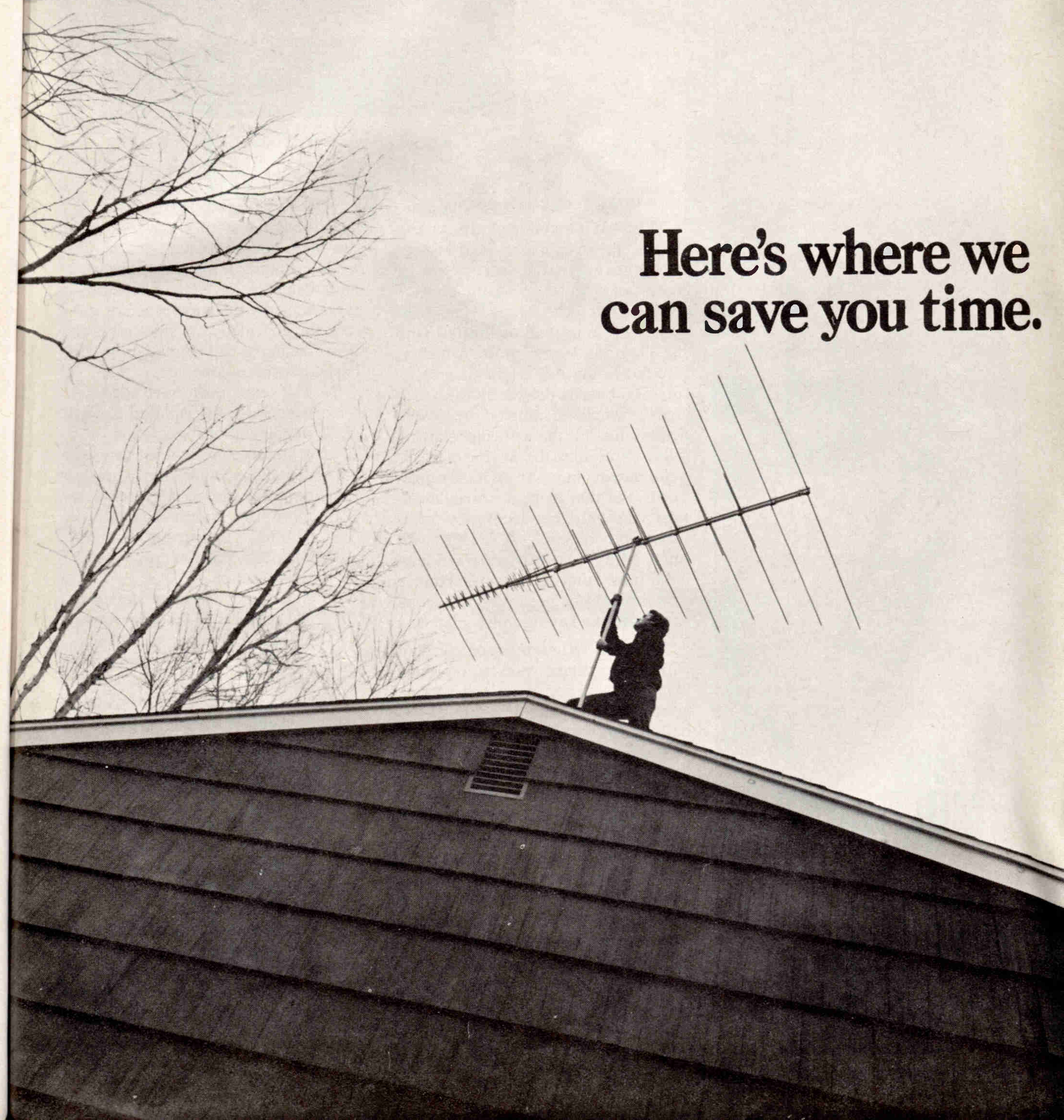
You also need high gain—that's obvious. But coupled with high directivity to knock out interference. Polar patterns from our antennas show almost complete rejection of signals from the rear and sides.

We designed our antennas so you wouldn't have to (1) climb back up there or (2) fiddle around up there.

We know that the fiddler on the roof is just fiddling his own money away.

For more information on our line of antennas see your Sylvania distributor.

SYLVANIA
GENERAL TELEPHONE & ELECTRONICS



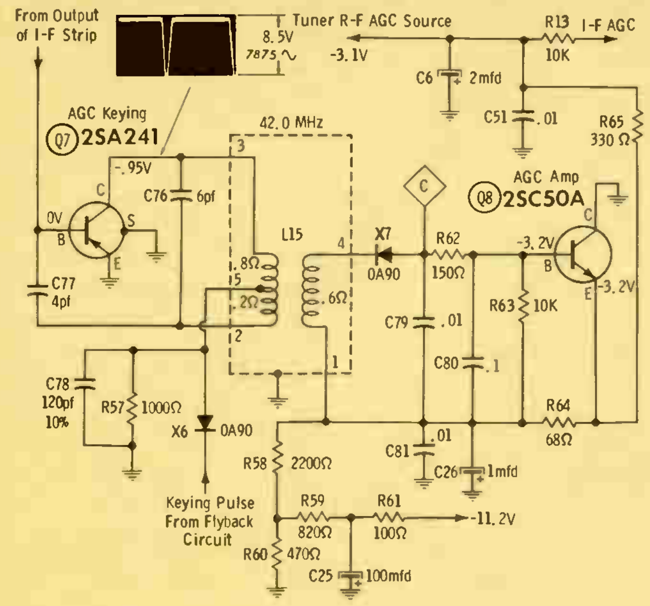


Fig. 25 A typical transistor AGC system.

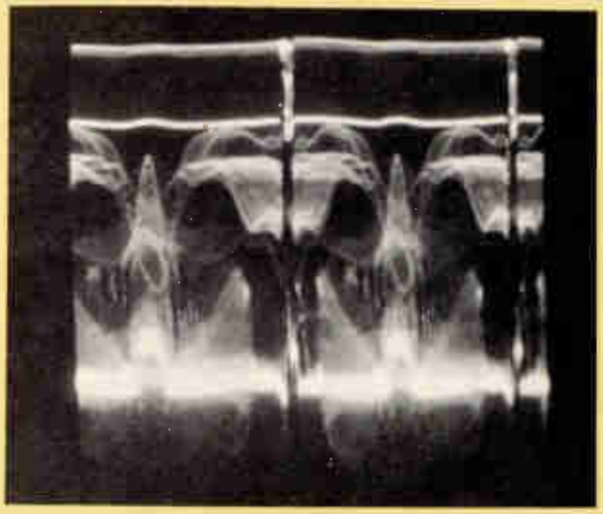


Fig. 26 A normal video-signal waveform.

parison waveform causes a change in the output pulse width. An increase in pulse width produces an increased average collector current flow in the transistor. This results in a DC correcting voltage increase, which corrects the operating frequency of the horizontal oscillator.

AGC Troubleshooting

Most AGC systems are keyed; that is, the AGC tube or transistor is triggered into conduction by means of a pulse from the flyback section (Fig. 25). The keying pulse coincides (in normal operation) with the horizontal sync pulse, which is also fed to the AGC tube or transistor. The base is driven by the video signal, which is sampled by switch action due to the collector keying pulse. Note that the keying pulse is quite narrow in many AGC arrangements and that its peak-to-peak voltage can only be accurately measured with a scope. A VTVM will often give a subnormal reading. Note also that a low-capacitance probe should be used with the scope to display the keying pulse.

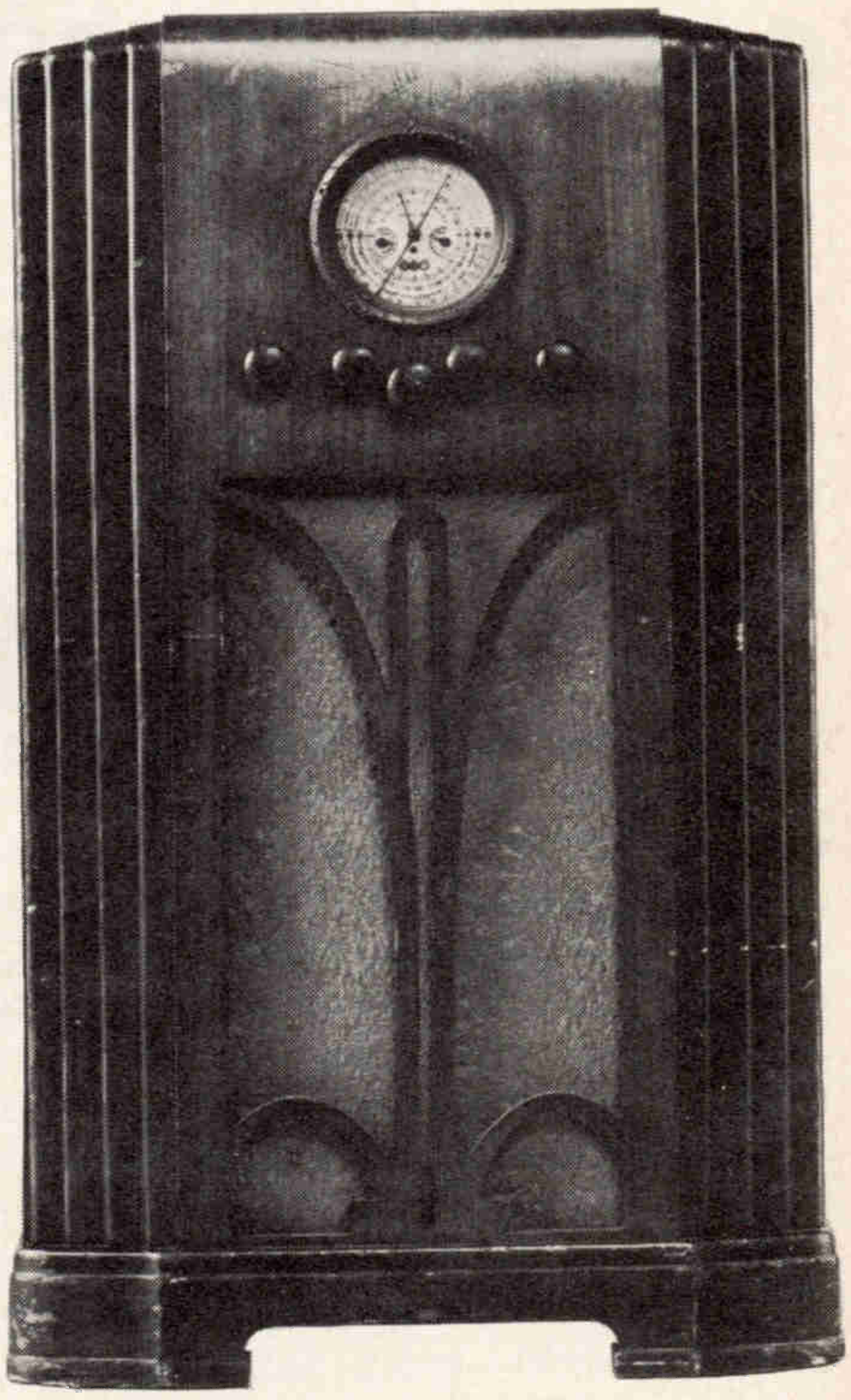
An AGC system must be checked with video signal present—preferably one supplied by a test-pattern generator. The generator output signal appears as illustrated in Fig. 26. One advantage of a generator signal is that it is under full control—the technician can check AGC waveforms with a signal level of a few microvolts or a hundred thousand microvolts. It is also possible to check white-screen, gray-screen and dark-screen patterns by substituting situable transparencies for the test-pattern slide. On the other hand, in the case of a program signal, the information is continually changing, and is not under the technician's control.

Conclusion

Although we have covered only the basic scope applications in TV troubleshooting, the examples that have been explained and illustrated serve to show the wide range of usefulness provided by this versatile instrument. In any application, the basic considerations are:

1. The scope must have adequate bandwidth to display the given signal without distortion.
2. A suitable probe must be used; depending upon the application, the probe may serve to minimize circuit loading or detuning, to provide demodulator action or to provide filtering action.
3. Electronic circuits have key test points and key waveforms; these are usually specified in the receiver service data.
4. Checks of key waveforms may be supplemented by tests at intermediate circuit points as needed—for example, to localize a defective coupling or bypass capacitor.
5. Scope patterns are most informative when the circuit under test is energized by signals with appropriate, or normal, characteristics.
6. Proficiency in troubleshooting TV with a scope is not acquired in a day or a week; it requires sustained and systematic study and experience. ▲

Heavyweight solder guns were hot news 30 years ago.



Now for a look at today's lighter news . . .

WEIGHS LESS THAN 5 OZ.

a featherlight solder gun for the delicate, dense micro-circuitry of the '70's. The new Ungar Solid State Solder Gun. Under five ounces. No dead-weight transformer.

To assure you damage-free soldering of IC's and FET's, the tip is "electrically-isolated"—no current leakage.

And, three different interchangeable micro-tips are included. You simply thread them on and off—no need to remove or replace heat cartridge. At a flip of the dual-heat selector switch, you have your choice of a safe 500° or 900°F tip temperature range.

So drop the heavy artillery. Ungar's got the solder gun (#6760) for the solid state age. Fast. Safe. Economical. Under 5 oz.
Call your nearest Ungar distributor or dealer now.
Or write directly for information.

Ungar®
Division of Eldon Industries, Inc., Dept. B2-1
Compton, California 90220

IN THE AGE OF SOLID STATE, UNGAR OUTGUNS THE HEAVYWEIGHTS.

Circle 16 on literature card

Automatic tint control comes to color TV

An analysis of how Magnavox's new ATC circuit produces purer flesh tones, plus tips on troubleshooting.

by Carl Babcoke

Some Common Tint Problems

Many color TV manufacturers now have deluxe models featuring automatic fine-tuning (AFT) to accurately adjust the fine tuning electronically, and automatic chroma gain control (ACC) to hold the color saturation nearly constant. One annoyance still remains in the frequent changes of hue that are not caused by the receiver. You undoubtedly have seen the ghastly purple or sickly green faces that were produced when the program source was changed from live newscasts to filmed commercials, from old movies to taped commercials, or from one TV channel to another. This is a many-sided problem with no single source or cure. Some cases are the result of the different color rendition of various brands of slide or movie film, while others may be due to an unbalance of the three primary colors in the TV camera.

These broadcast shortcomings can be minimized, but not eliminated, by receiver adjustments. Color hue changes caused by variation in the phase of the transmitted burst signal usually can be restored by repeated use of the hue control on the receiver. However, this activity is often accompanied by a marked increase in the viewers blood pressure.

Some system to adjust the hue automatically is very desirable. At first thought, one solution would be to use a phase detector to electronically maintain a constant hue. Unfortunately, there is no standard to compare the burst phase against.

How Magnavox's ATC Works

One practical answer to this distressing hue problem is found in the Magnavox color receivers that use the T940 chassis. The manufacturer calls these models Total Automatic Color (TAC) since they have AFT, ACC and ATC (automatic tint control). Their ATC circuit changes all the yellow and red areas of the picture to an orange that is acceptable as skin color. Thus, skin color that ordinarily would look slightly green or purple will be rendered as orange so long as the ATC is switched on.

The ATC circuit board has no tubes, but uses diodes and transistors. It is mounted on the tuner mounting assembly and is completely shielded. A picture of the

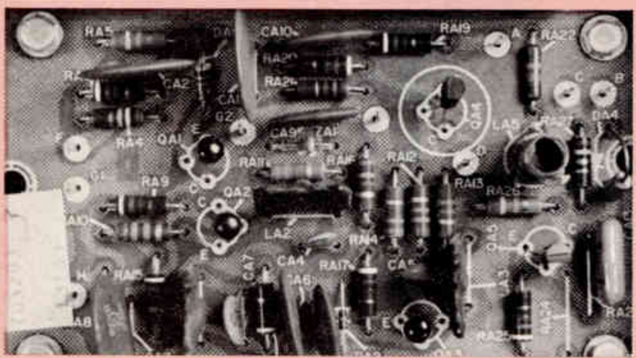


Fig. 1 (A) Circuit board and components for the Magnavox ATC circuit.

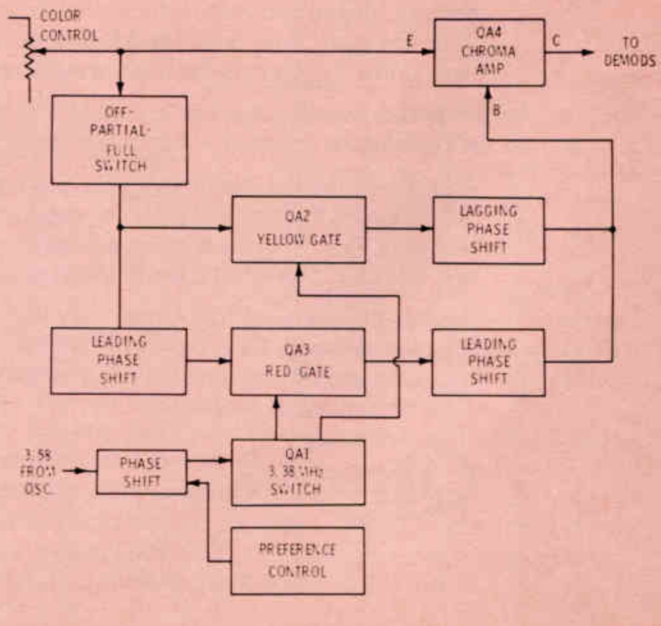


Fig. 1 (B) Block diagram of the ATC circuit.

component locations and a block diagram of the circuit are shown in Fig. 1.

The amount of ATC correction is selected manually by a three-position switch on the front panel which provides OFF (no correction), PARTIAL-correction and FULL-correction. The ATC circuit is inserted electronically between the moveable arm of the color control and the demodulators. There are two parallel paths for the chroma signal: one to the emitter of QA4, the chroma amplifier transistor, that produces an amplified, but not phase-inverted, signal at the collector. The phase correction path is through the Red and Yellow gate transistors, with their combined outputs going to the base of QA4. Since the gate transistors invert the signal, and the signal at the base of QA4 is inverted again before appearing at the collector, both of these signal paths are in-phase at the collector of QA4.

Fig. 2 illustrates a color wheel that shows the hues obtained when a chroma signal of the phases listed is compared (in a demodulator circuit) with the phase of the burst signal. Magnavox has chosen a chroma signal with a phase of 57° to give the desired reddish-orange skin color. The basic action of the ATC circuit is to change the yellow and red signal phases (those on either side of orange) to 57° without changing the phases of green, cyan and blue. This is the reason for keying off the gate transistors during the time the green, cyan and blue hues are displayed on the television screen.

The entire circuit is shown in Fig. 3. Both gate transistors are

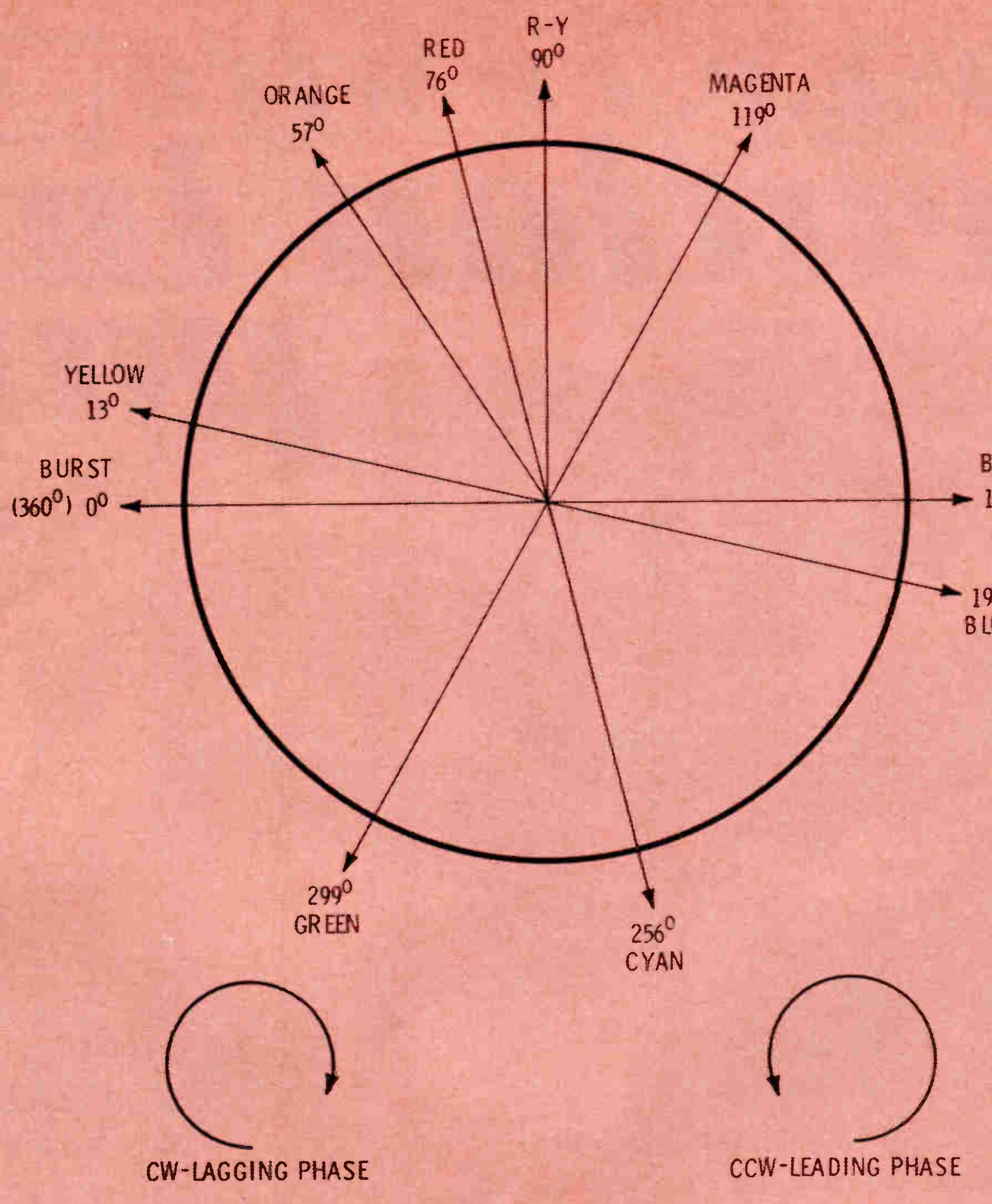


Fig. 2 A color wheel shows the phase (compared to burst) of the chroma signal necessary to obtain various hues.

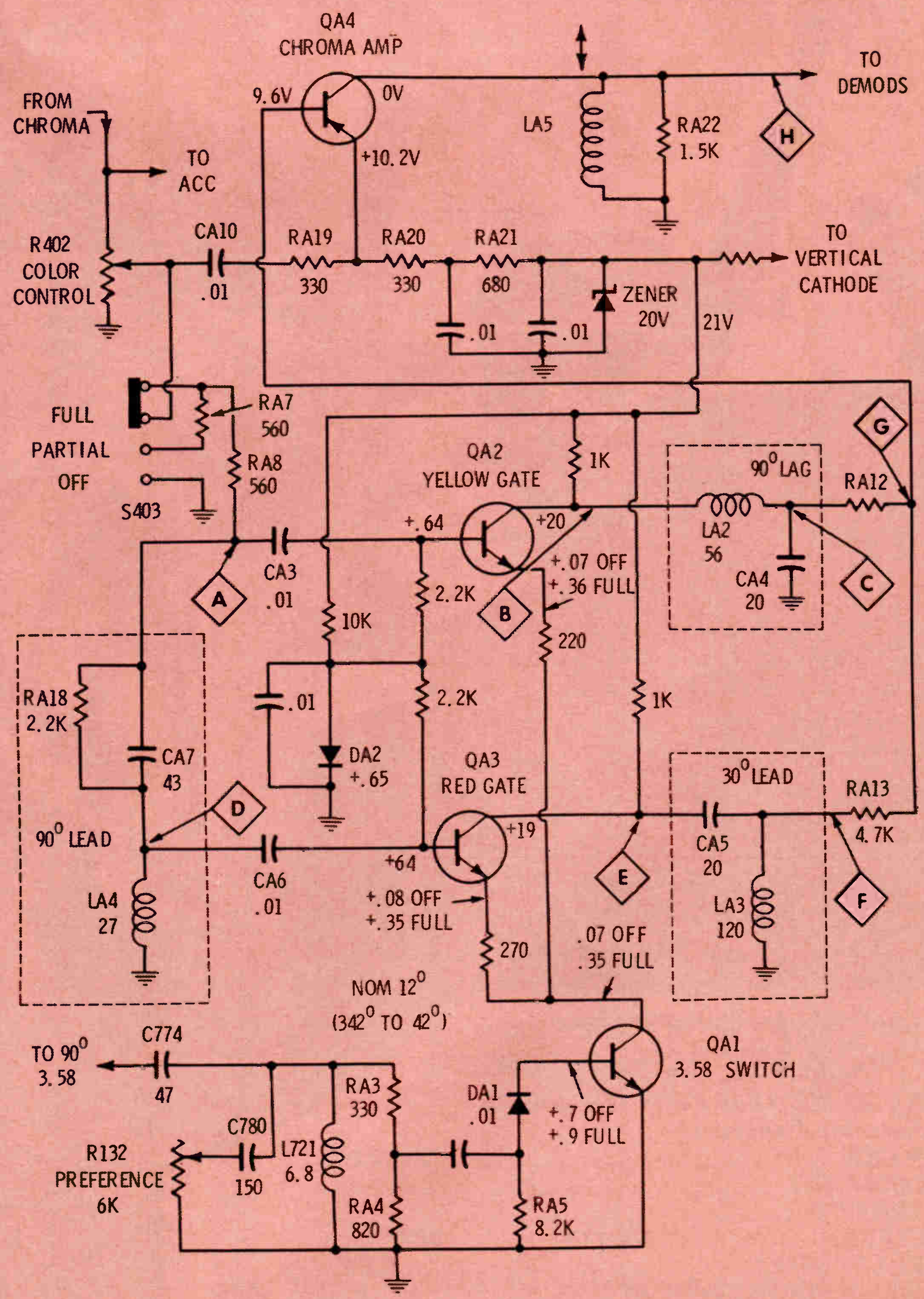
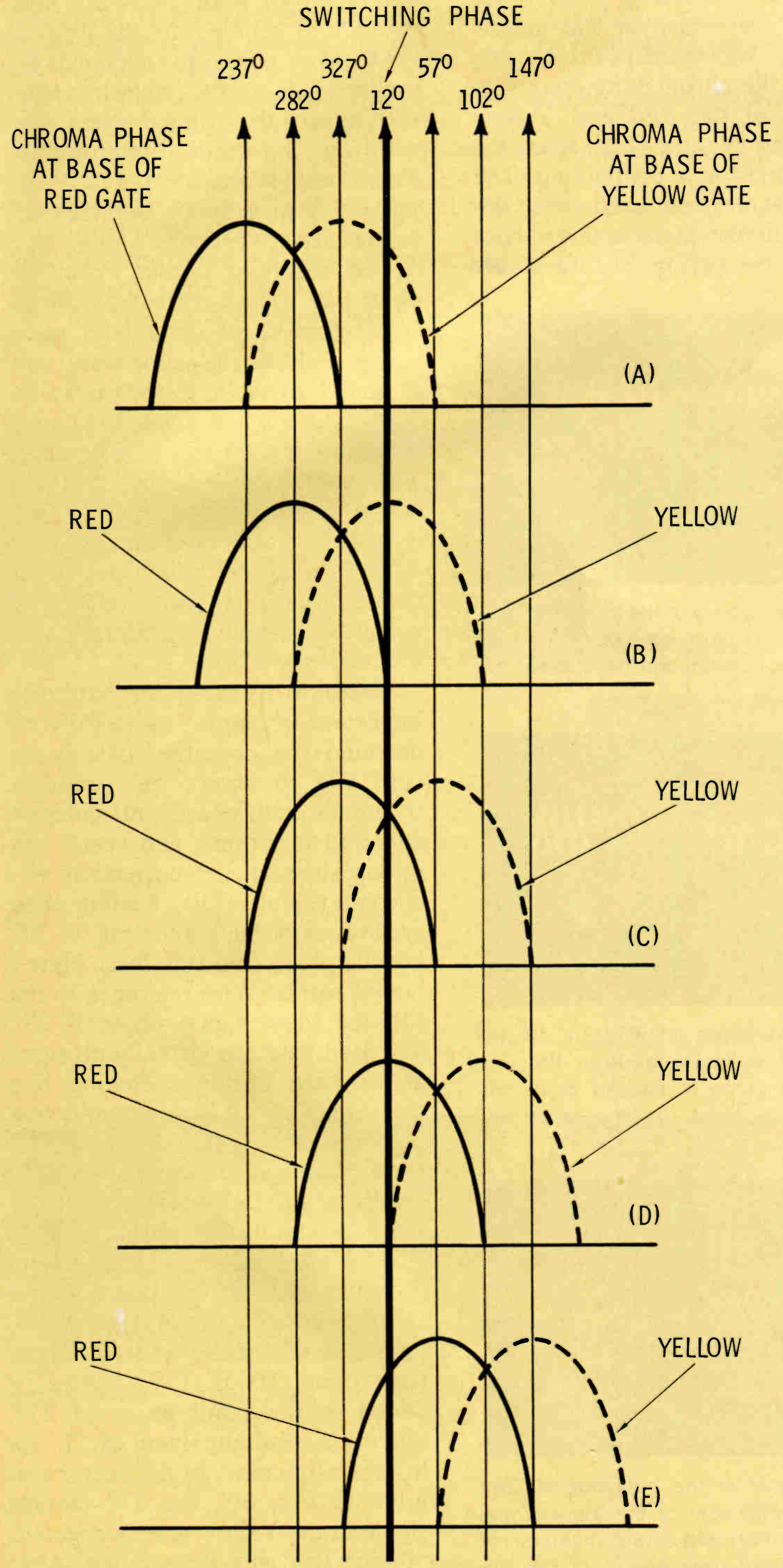


Fig. 3 The complete schematic of the Magnavox T940 AFT circuit.

Circle 17 on literature card

non-conducting until two conditions are fulfilled. The gates are operated in Class "B", and, in the absence of an AC signal (chroma) at the bases, the forward bias is insufficient to allow any significant gain or collector current. Forward bias of just over .6 volt for the bases of both gates is developed across silicon diode DA2. Voltage from this source is temperature compensated, and any increase of base current in the silicon gate transistors resulting from a higher temperature will be reduced by a lower voltage drop across the diode.

In addition, the Red and Yellow gate emitters are returned to ground through the collector-emitter path of QA1, the switch transistor. The gates cannot conduct regardless of base



(A) Input phase is 327°, or greenish-yellow. There is a fairly large amplitude during the 12° sampling time at the base of the Yellow gate. This will give partial correction. The signal at the base of the Red gate is negative, so there will be no collector current.

(B) The input phase is 12° or yellow. Amplitude at the base of the Yellow gate is maximum, which will give full correction and make skin color orange. There is still no output from the Red gate since the base signal is zero.

(C) Input phase is 57°, or the desired orange skin color. Partial and equal signal voltages appear at each base. The resulting small corrections cancel out, leaving the output still at 57°.

(D) Input phase is 102°, or purple. The Yellow gate base signal is zero; therefore, there is no output. Input to the Red gate is at maximum and will give full correction to bring the skin color to orange.

(E) Input phase is 147°, or nearly blue. The voltage at the base of the Yellow gate is negative, so there will be no output. Enough signal appears at the base of the Red gate to give partial correction and bring the skin color back to bluish-red.

Fig. 4 The amplitude of the chroma sine wave at the base of each gate, during the time the switching transistor has full conduction, determines the collector current. Note that the ATC input signal phase is the same as the phase at the base of the Yellow gate.

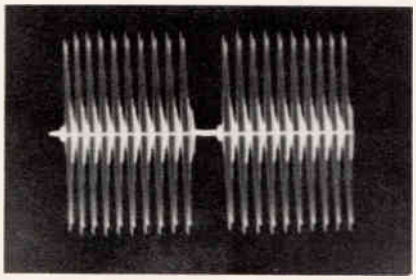
voltage until the switch transistor conducts. A 90° 3.58-MHz signal from the color oscillator transformer is shifted in phase by C774, C780 and L721. The preference control, R132, varies the phase angle 30° on either side of the nominal phase of 12°. This signal is rectified by diode DA1, and the resultant pulsating DC voltage of positive polarity is applied to the base of QA1, the switch transistor. The values are chosen so QA1 will draw current and be a virtual short circuit only during the very tip of the positive-going voltage applied to its base. During the rest of the cycle it is an open circuit, which disables the gates.

When the switching transistor is conducting and a positive chroma signal is present at the base of QA2, the Yellow gate, the base will be forward biased enough for collector current to flow and the transistor to amplify. The same conditions apply at the Red gate, QA3, except that the chroma signal applied to the base has a 90° leading phase compared to the phase at the yellow gate. Fig. 4 shows the positive-going halves of the chroma sine waves at the bases of the Red and Yellow gates during the time (12°) when the switch transistor is conducting. The output signal from each gate depends upon the instantaneous base voltage at the keying time, and **only** at this time. The more gate output signal, the more phase correction is possible.

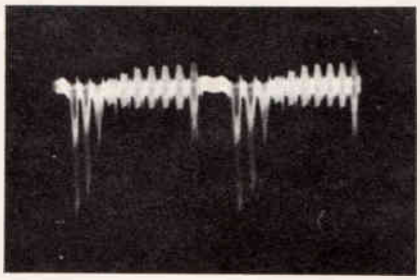
The gated signal at the collector of the Yellow gate is shifted by a 90° lag circuit consisting of LA2 and CA4. Similarly, the output of the Red gate is shifted to 30° (leading) by CA5 and LA3. The signal outputs from both gates are combined and applied to the base of QA4. After phase inversion this signal appears at the collector along with part of the original chroma signal from the input to the emitter. These two signals are never seen separately on a scope, for they add vectorially to become a sine wave of the resultant phase. From this point the phase-corrected chroma signal goes to the demodulators.

Fig. 5 shows the scope waveforms at the designated testpoints in the ATC cirucit when a gated color-bar generator is used as a signal source. The output tuning coil, LA5, is tuned by stray capacitance to form a low-Q circuit resonant to about 3.58 MHz. The function of the tuned circuit is to "ring" the clipped correction signal into a more symmetrical waveform.

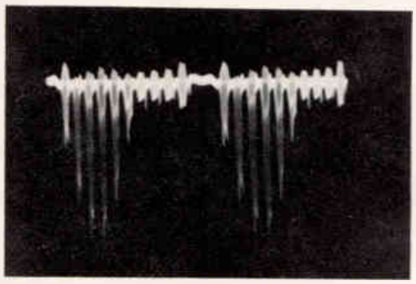
Vector diagrams are extremely important in helping us to fully understand the operation of this circuit. Fig. 6 shows the simplified schematic with phase shift components and testpoints, and vector diagrams showing the correction of a chroma signal of 30° leading phase (yellow skin hue) and one of 30° lagging phase (red skin hue). Here is how it works: With reference to Fig. 6B, the input signal phase is 27°. The Red gate has virtually no signal at its base during switching time (see Fig. 4), so it is non-conducting. The base of the Yellow gate has the same phase as the input (27°). After inversion in the transistor, the collector (testpoint B) phase is 207°. The 90° lagging circuit changes the phase to 297° at test points C and G of Fig. 6A. QA4 inverts the phase, so the phase at its collector (test point H) is 117°, which is added to the input phase of 27°, making a resultant signal of 57° for orange skin color. In the vector diagram in Fig. 6C, the 87° chroma signal at the Yellow gate is negative, making this gate inoperative. After the 90° lead change, the signal at the base (test point D) of the Red gate is 357°, and QA3 inverts the phase



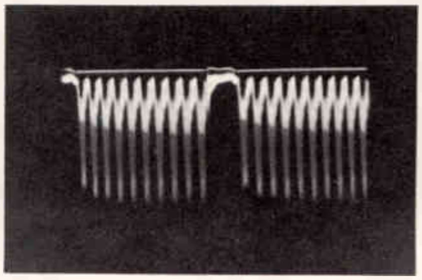
(A) The normal keyed-rainbow pulses at the input (test point A), also at the emitter of QA4, the chroma amplifier.



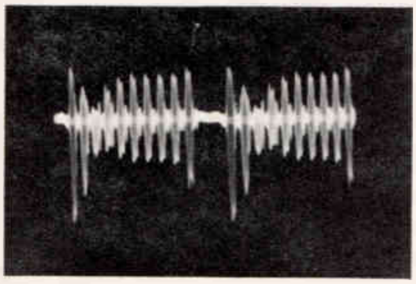
(B) Negative-going pulses at the collector of the Yellow gate (test point B). Maximum correction will be at color bar #1.



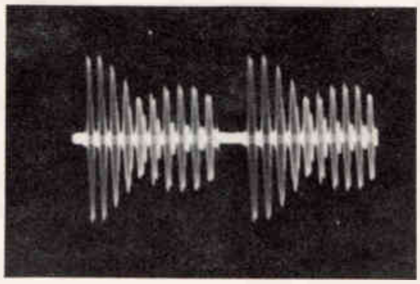
(C) Signal at the collector of the Red gate (test point E). Maximum correction will be at color bars 3 and 4.



(D) Negative-going "tails" on all ten bars at the collector of both the Red and Yellow gates is caused by a collector-emitter short in the switching transistor.



(E) Waveform at the base of QA4 (test point G) is the resultant of the output from the Red and Yellow gates.



(F) The signal at the collector of QA4 is the vectorial sum of the input signal (input at emitter) and a 180° inversion of the signal at the base (test point G). The larger amplitude of color bars 1, 2, and 3 is incidental, but it does make all the orange colors brighter.

Fig. 5 Chroma signal waveforms at each stage of the ATC circuit.

smooth

RCA WP-700A, 702A, 703A and 704A constant voltage dc power supplies are all solid-state. A negative feedback circuit maintains constant output voltage with low ripple—regardless of varying line. In fact, at rated load, these supplies are so smooth that "they hardly cause a ripple."

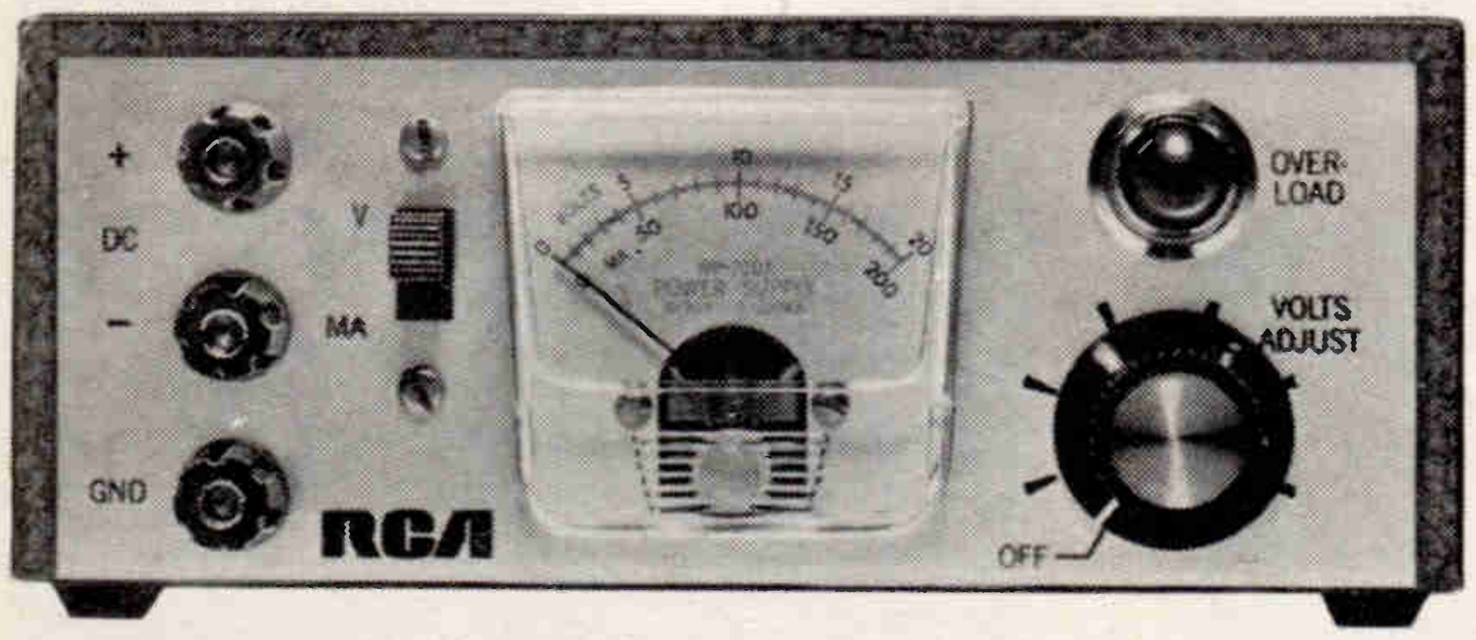
They are versatile bench-type units—ideally suited for use in circuit design, servicing, industrial, and educational applications.

Output voltage of the WP-700A and WP-702A is continuously adjustable from 0 to 20 volts at current levels up to 200 mA.

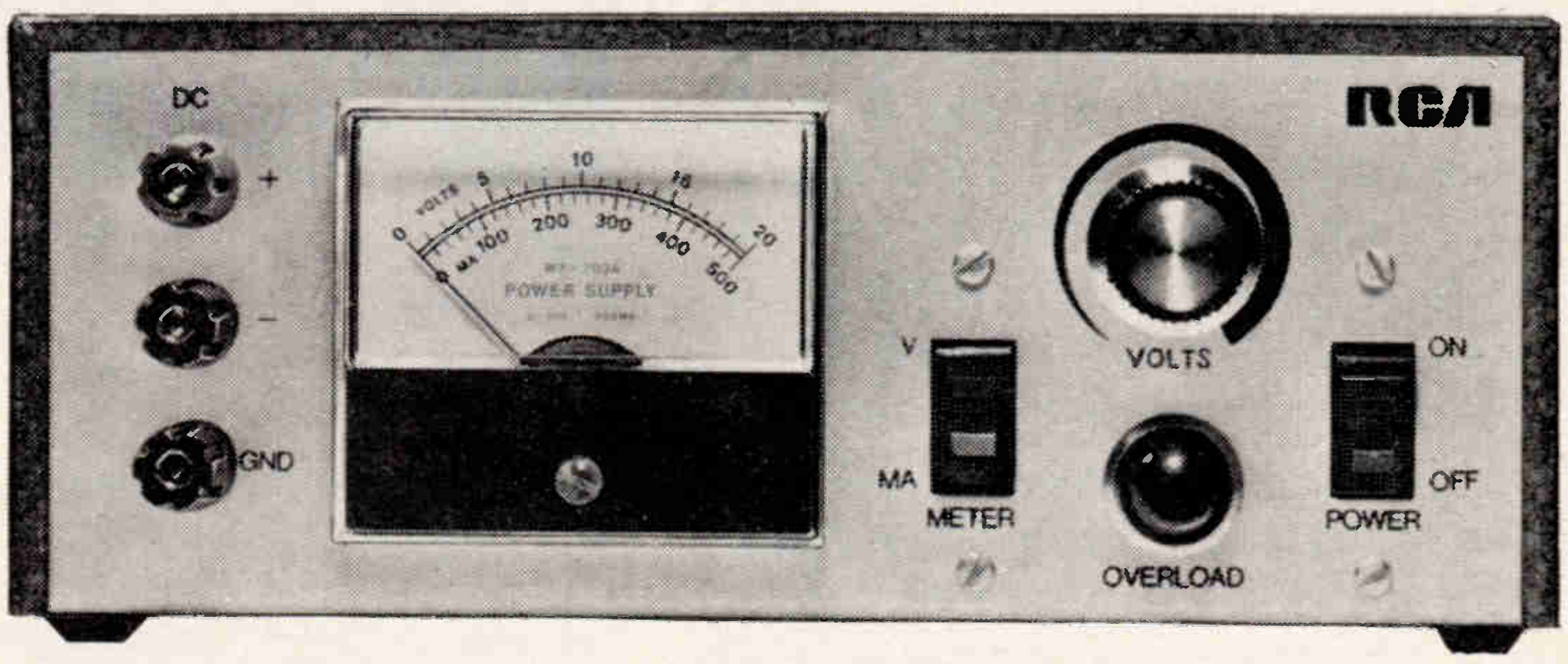
Output voltage of the WP-703A is continuously adjustable from 0 to 20 volts at current levels up to 500 mA.

Output voltage of the WP-704A is continuously adjustable from 0 to 40 volts at current levels up to 250 mA.

All four power supplies have built-in electronic short-circuit protection—and a front panel overload-indicator that signals approach to maximum rated current level.

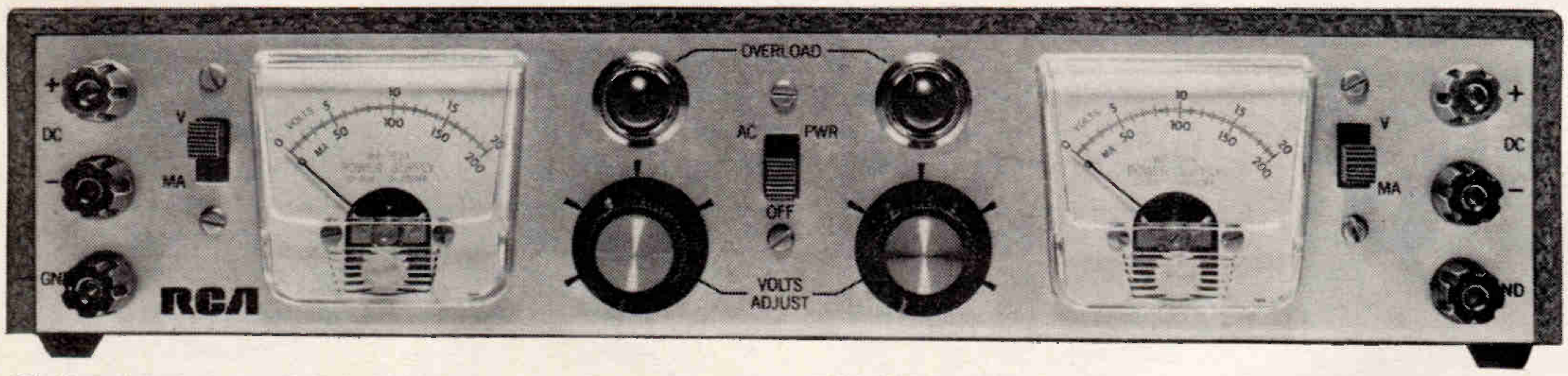


WP-700A: $40.00* (five or more) $48.00* (less than five)



WP-703A: $49.00* (five or more) $58.00* (less than five)

WP-704A: $49.00* (five or more) $58.00* (less than five)



*Optional Distributor Resale Price.

WP-702A: Siamese Twins of WP-700A, but electrically isolated $73.00* (five or more) $87.00* (less than five)

For further information write: RCA Electronic Components, Commercial Engineering, Department J-93W, Harrison, N. J. 07029.

Look to RCA for instruments to test/measure/view/monitor/generate

RCA

Circle 18 on literature card

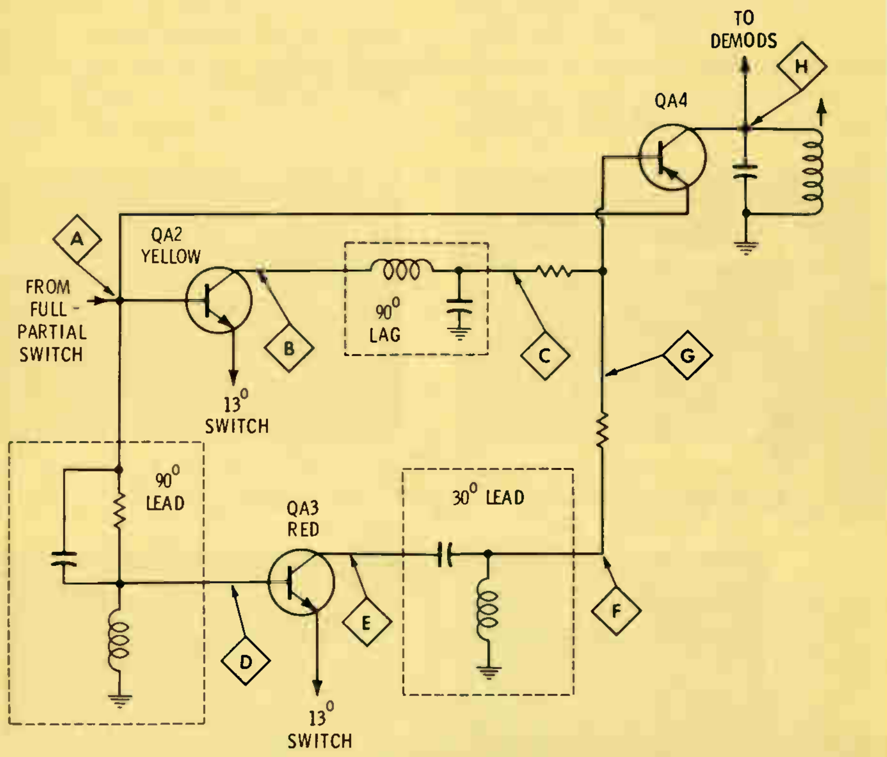
to 177° at the collector (test point E). The 30° leading network shifts the phase to 147° at test points F and G. After inversion by QA4, the phase at the collector (test point H) is 327°, which added to the input phase of 87° gives a resultant phase of 57° for orange skin color.

In the demodulators, phase differences become amplitude differences. The scope waveforms shown in Fig. 7 were taken from the picture tube grids, both with no ATC action and with full correction. In general, the pulses representing color bars become nearly identical for the first four bars. This statement is confirmed by color pictures of the color bar pattern on the screen of the picture tube. The large negative-going spike in each waveform is the horizontal blanking spike that comes from the –Y amplifiers whether any color is there or not.

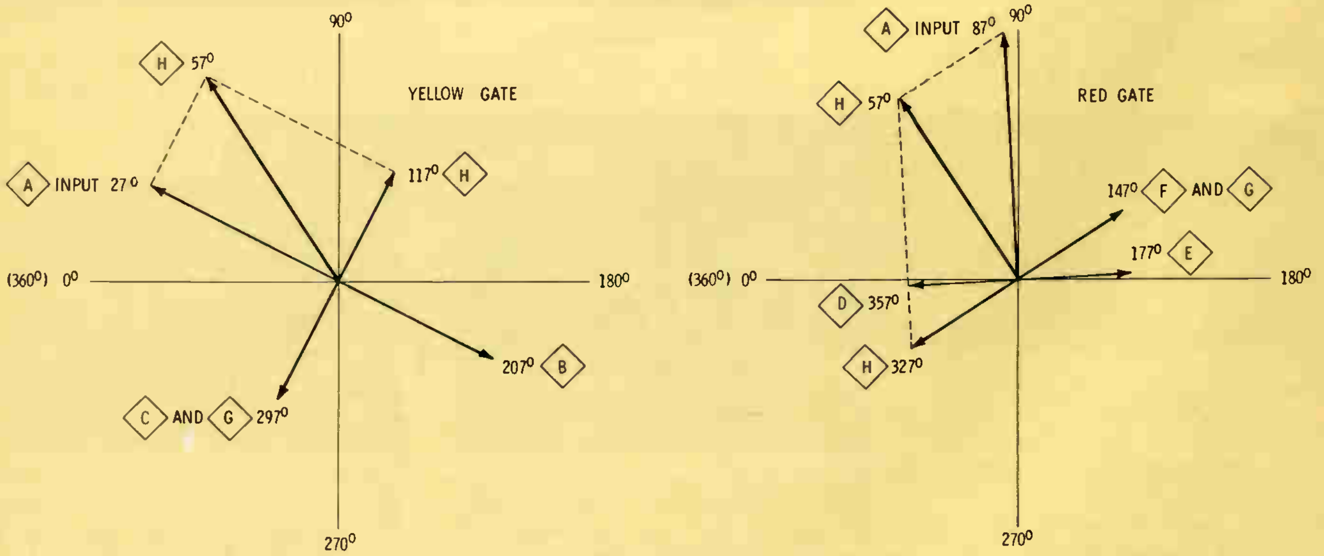
Vector patterns from the scope give the fastest and most accurate visualization of the ATC action, as shown in Fig. 8. With the ATC switch in the FULL correction position, the first three color bars have the same phase (57°), the fourth and tenth bars have some correction, and the other five bars are not affected.

Magnavox ACC

Another feature of the T940 Magnavox chassis is the ACC circuit which has a double action. As shown in the simplified schematic of Fig. 9, a total of four DC voltages are applied to the grid return of the chroma IF tube: 1) Negative voltage from the plate of the color killer is applied when the burst level is too low or missing. 2) Negative voltage from a killer detector diode is obtained through the 8.2-meg resistor. This voltage varies according to the amplitude of the burst signal. 3) A positive voltage applied through the 1.5-meg resistor from its own cathode cancels some of the negative voltage from the killer detector to cause more of the change in control voltage (from the burst) to reach the grid. 4) In addition to these conventional voltages, a variable positive voltage comes from QA5, the ACC transistor. Chroma voltage from the top of the color control is rectified by diode DA4, filtered by CA13 and applied to the base of QA5. The more positive the base voltage, the less positive the



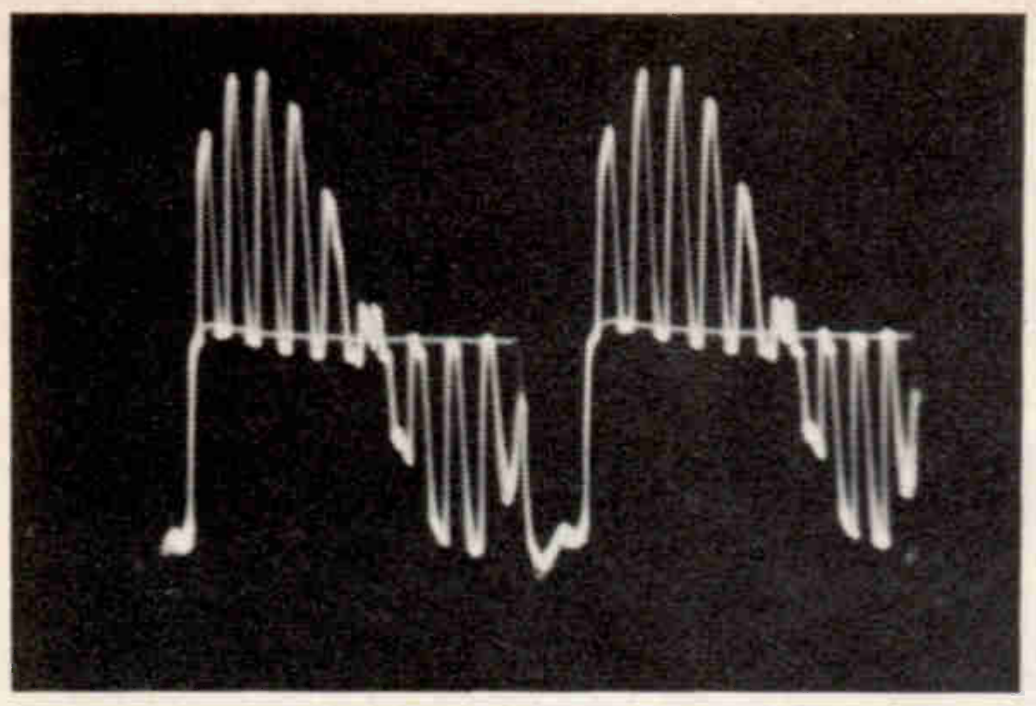
(A) Simplified schematic with test points and phase shift components.



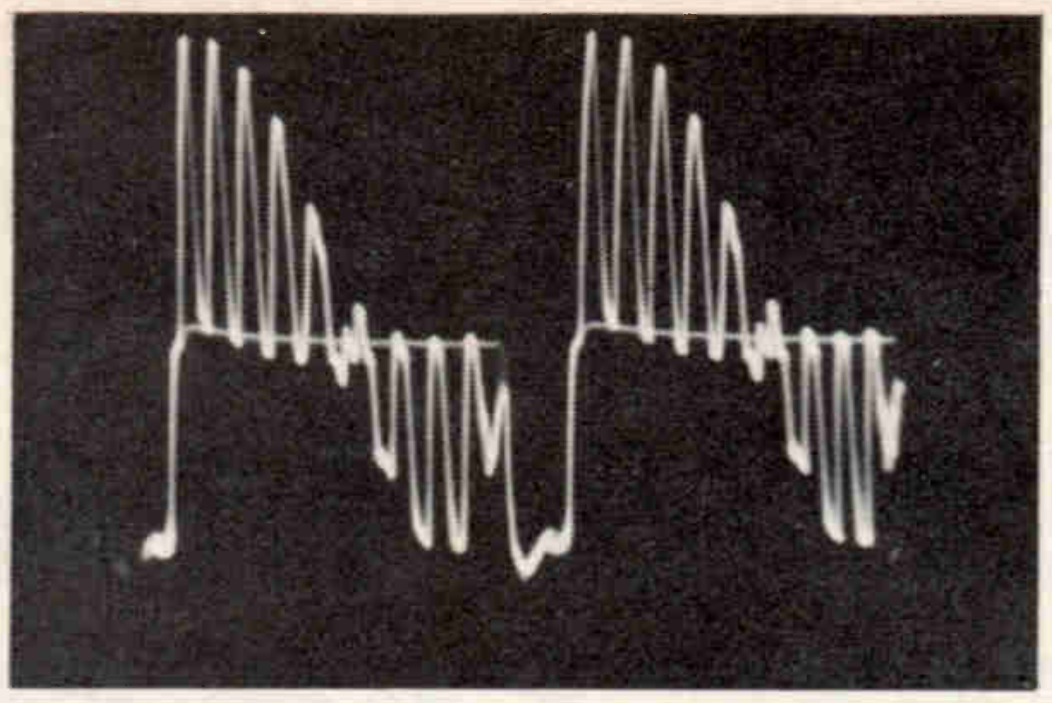
(B) Vectorgram for ATC correction of a 30° leading (27°) input chroma phase.

(C) Vectorgram for ATC correction of a 30° lagging (87°) input chroma phase.

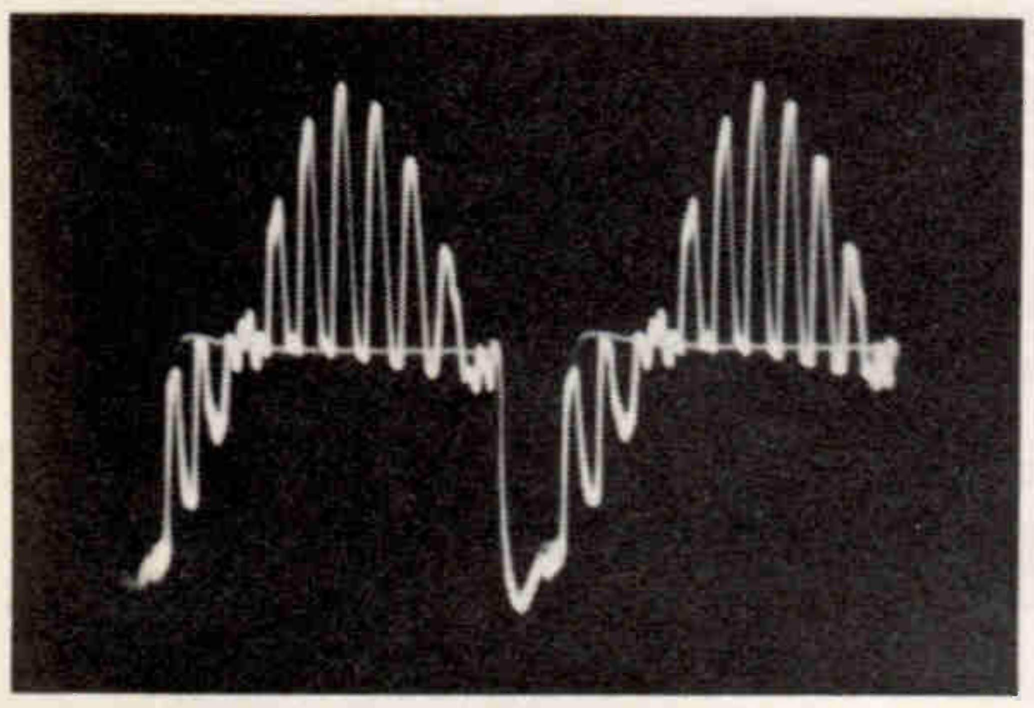
Fig. 6 Simplified schematic and vectorgrams for ATC correction.



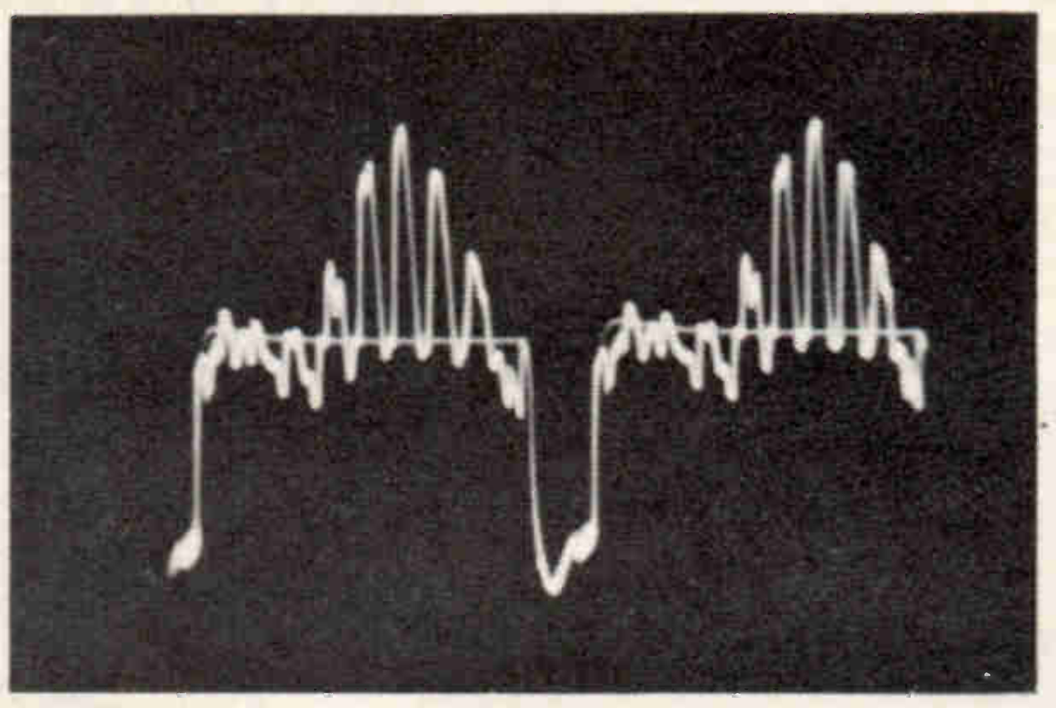
(A) Normal bar pattern at the red grid of the picture tube.



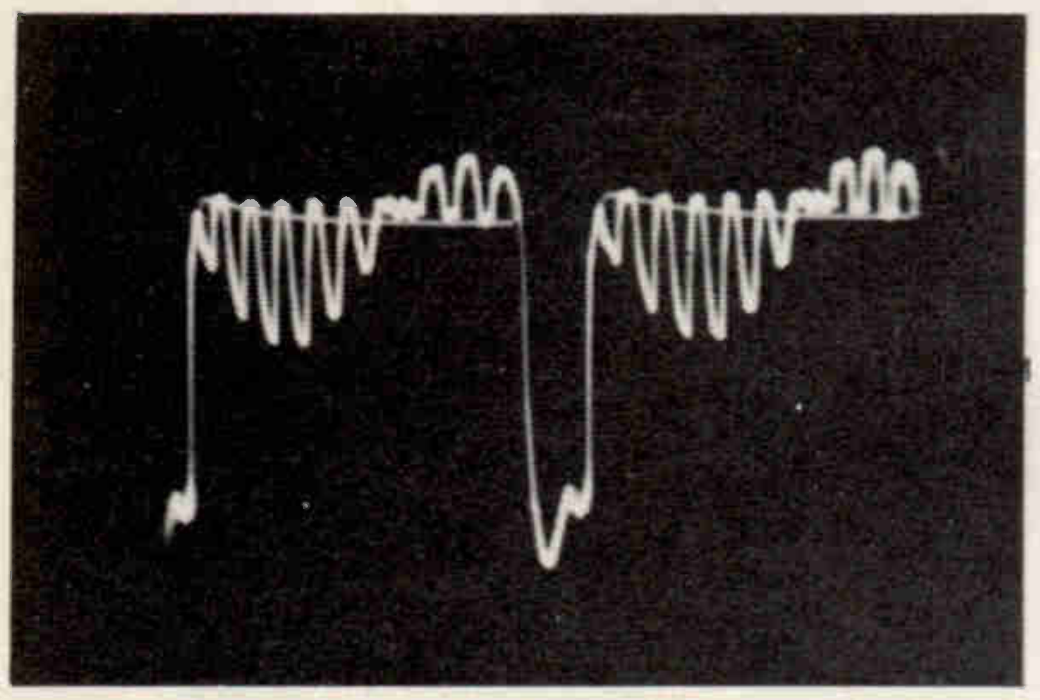
(D) Blue grid with FULL ATC correction.



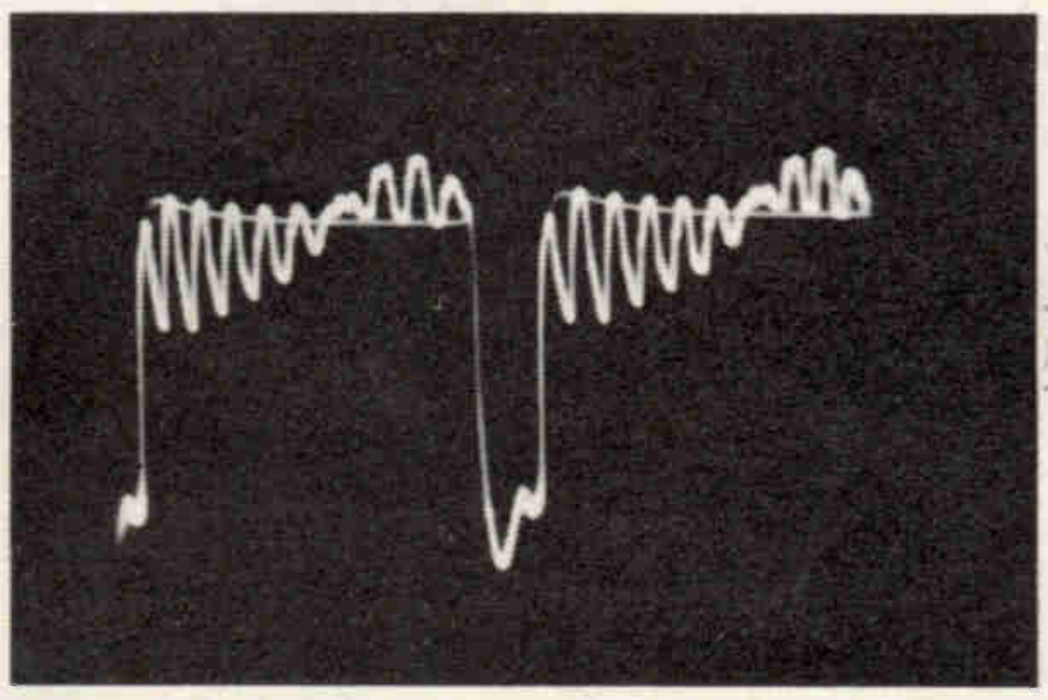
(B) Red grid with FULL ATC correction.



(E) Normal bar pattern at the green grid of the picture tube.



(C) Normal bar pattern at the blue grid of the picture tube.



(F) Green grid with FULL ATC correction.

Fig. 7 Picture tube grid waveforms produced by a gated-rainbow pattern.

TABLE 1

DC voltage chart of the ACC circuit. The high chroma IF bias at 0% is due to color killer action. The last three lines are the chroma IB tube voltages without the additional bias from QA5.

ACC VOLTAGES

measuring point	0%	50%	100%	150%	200%
	(both ACC circuits working) chroma level at generator				
chroma IF cathode #7	3.6	9.2	7.0	6.0	5.6
chroma IF grid #2	-29	6.2	.5	-2.4	-3.5
chroma IF ACC bias	-32	-3	-6.5	-8.4	-9.1
QA5 collector	21	15	9	6.3	5
QA5 base	0	1.5	3.1	3.7	4.0
QA5 emitter	0	1.15	2.6	3.1	3.35
CR701A killer detector	-13	-28	-41	-46	-48
	(with QA5 base grounded)				
chroma IF cathode	3.5	9.2	8.6	8.0	7.7
chroma IF grid	-28	6.6	5.0	3.2	2.6
chroma IF ACC bias	-31	-2.6	-3.6	-4.8	-4.1

collector voltage, which is applied through a 1.5-meg resistor to the grid return of the chroma IF tube. This voltage also cancels out part of the negative voltage obtained from the killer detector, and since it is variable, makes the ACC voltage at the chroma IF tube more negative when the color is stronger.

The DC voltage chart in Table 1 gives the important voltages in the ACC circuit. ACC voltages were obtained by comparing the chroma IF grid and cathode voltages measured to ground; this is the easiest way during troubleshooting. Slightly better accuracy can be obtained by measuring directly from cathode to the .047-mfd capacitor in the grid circuit. The difference in the voltage reading of the chroma IF ACC bias and the same reading with the base of QA5 grounded represents the added ACC gain correction obtained from the QA5 circuit. This extra control is very noticeable above chroma level of 75%.

You might think that obtaining part of the ACC from the amplitude of the chroma signal, rather than the burst amplitude alone, would defeat the natural color saturation in scenes having bright colors or others with little color. While there is some of this effect, it is overshadowed by the minimizing of another common problem: The many times a station will broadcast extremely strong or abnormally weak color without any corresponding change in the burst.

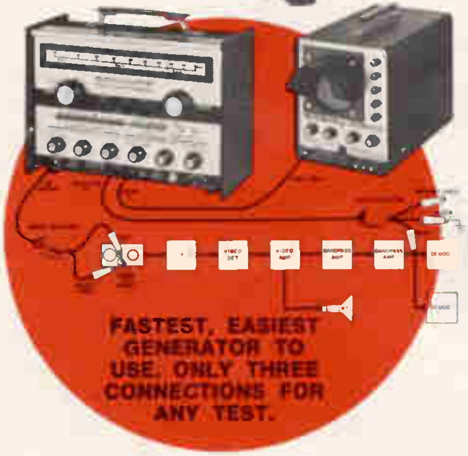
Troubleshooting the ATC Circuit

The first step in analyzing any ATC malfunction is to try the normal sequence of customer adjustments. Slide the ATC switch (on the front panel) to the OFF position, and with a color picture tuned in, adjust the tint control for normal skin color. If it is impossible to obtain good skin color, the ATC circuit is **not** at fault. If the picture has normal tint and saturation, QA4, the chroma amplifier on the ATC board is working and the circuit has B+ voltage. Weak or missing color can be caused by the color IF, video IF's, killer detector, 3.58-MHz oscillator, etc., the same as in any color TV. Connect a jumper wire from the top of the color control to the demodulator grid, pin 7; if the color improves, the ATC circuitry is at fault.

(Continued on page 36)

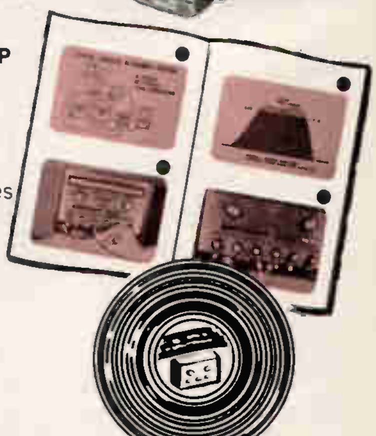
The only *complete*
SWEEP & MARKER GENERATOR
$395.00

ALL SOLID STATE-INSTANT ON



FREE WITH YOUR SWEEP AND MARKER:

80 full color reproductions direct from Sencore technical training film clearly depicts alignment from beginning to end using SM152. Pictures are numbered so you can review a section at a time if you are in trouble. 35 minute LP record direct from film clearly leads you all the way. Also packed with each SM152. Numbers are announced for each picture so you can review a section when necessary.



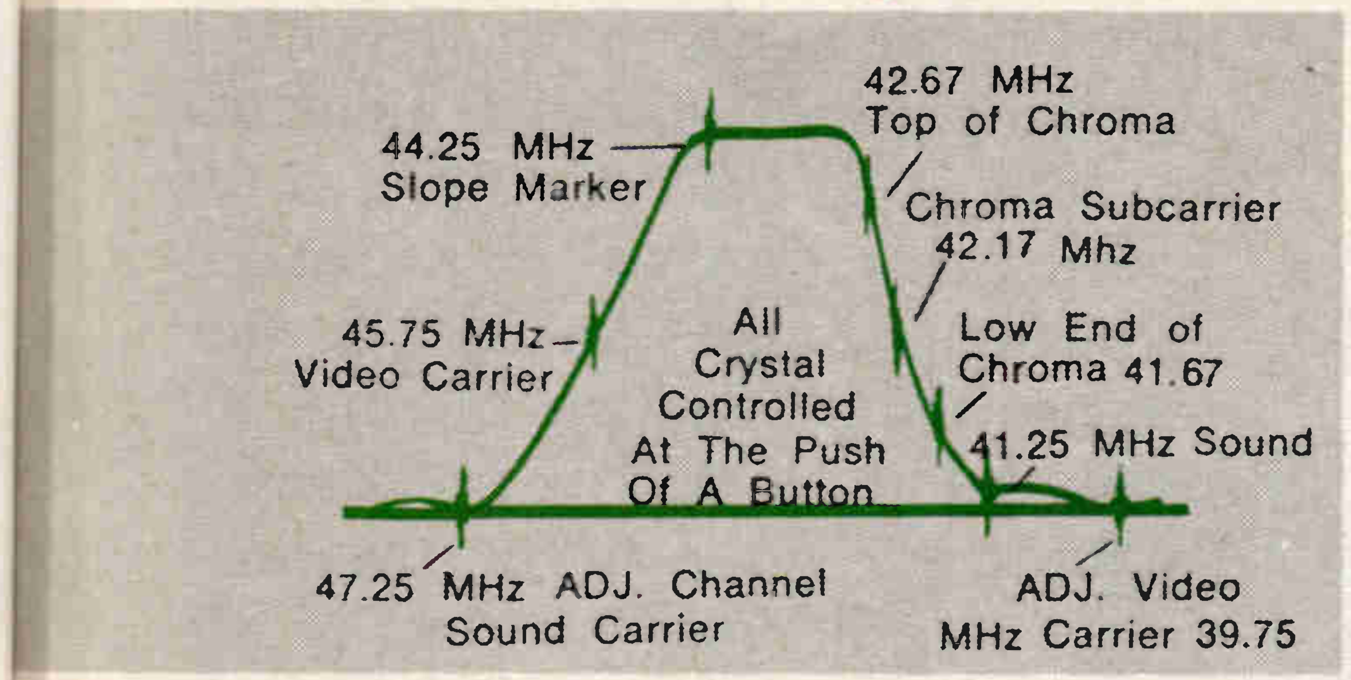
SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

ONLY GENERATOR THAT GIVES YOU A COMPLETE IF, CHROMA, ALL CHANNEL VHF, UHF AND FM ALIGNMENT SIGNALS IN ONE UNIT

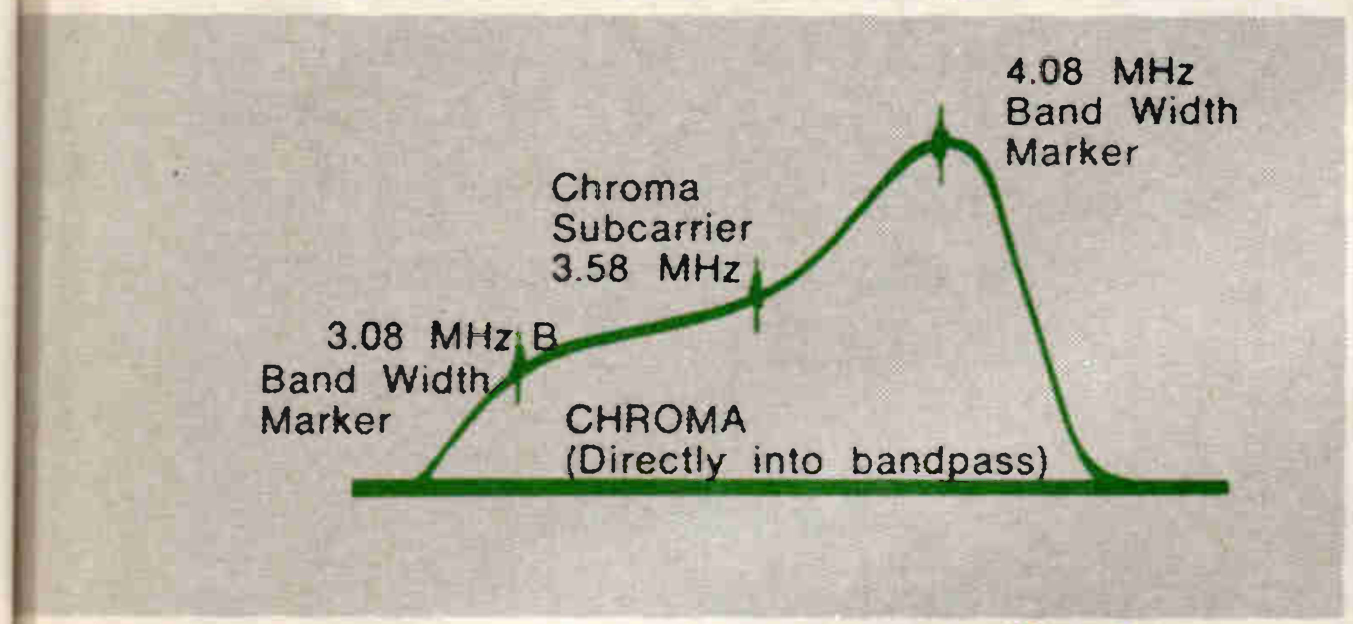
complete IF SWEEP AND CRYSTAL CONTROLLED MARKERS



View the complete IF response curve with full 15 MHz sweep width (competition has only 12 MHz, restricting view on RF and some solid state receivers that have extra traps). Press one or all of the crystal controlled marker push buttons without upsetting response curve. Post injection is used all the way to prevent overloading the TV receiver. Crystal markers are provided for all critical check points as shown on the response curve. Also sweeps 20 MHz IFs as found on older sets and new import color sets. Major competition does not cover these frequencies. Special spot align position converts the sweep generator to a regular signal generator for spot alignment or dipping odd traps. Only Sencore goes all the way.

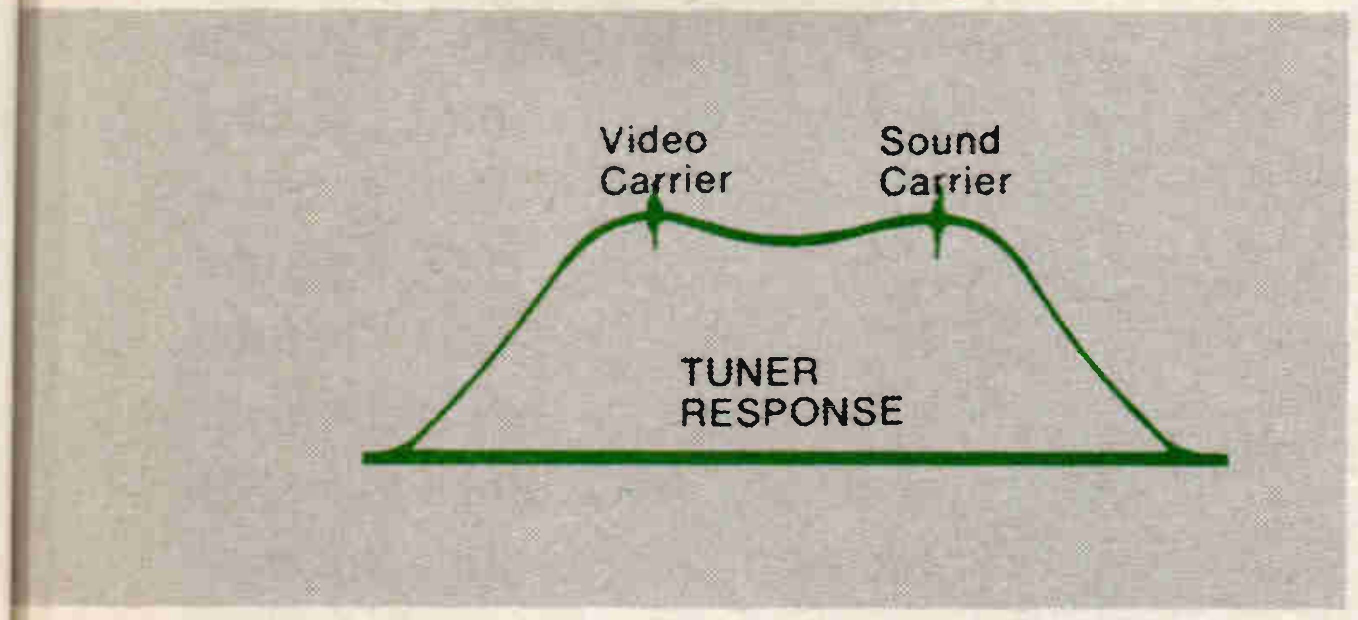
Note that Sencore has a base line giving you a reference to zero. Competitive models do not.

complete CHROMA SWEEP AND CRYSTAL CONTROLLED CHROMA MARKERS



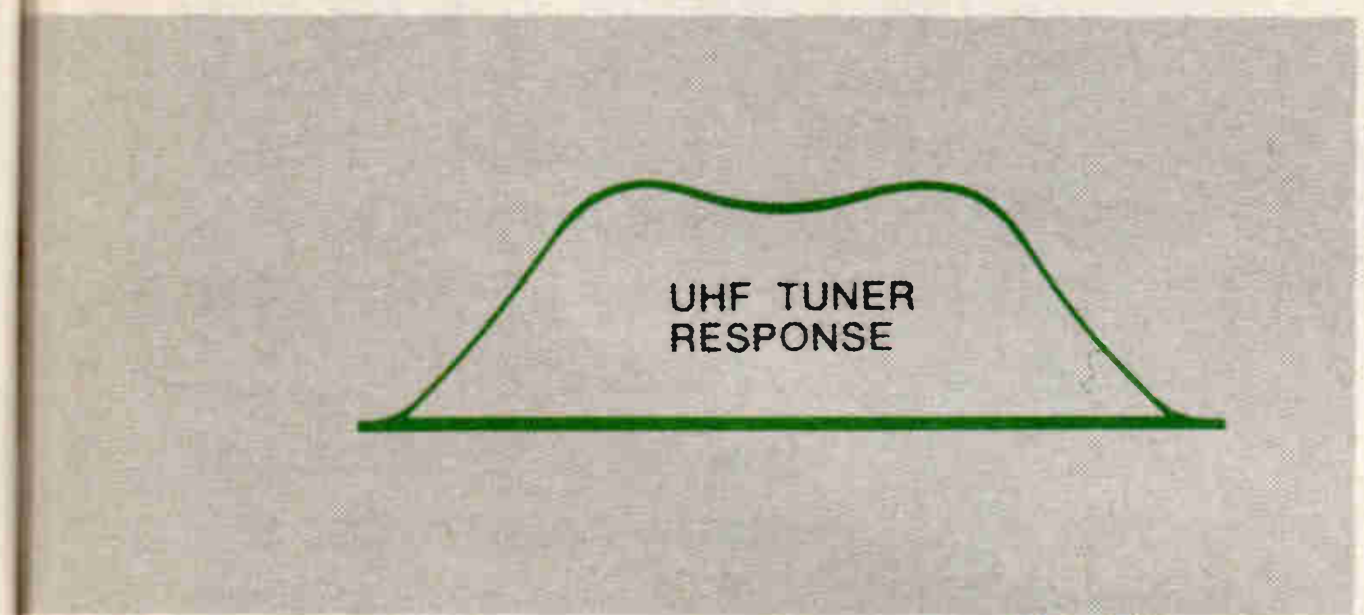
You can inject the chroma signal directly into the chroma amplifiers as shown here or through the IF amplifiers for a flat response. You are equipped to follow manufacturer's recommendation either way. Injection directly into the chroma amplifiers is a must for fast trouble shooting of color circuits.

complete ALIGNMENT SIGNALS FOR VHF TUNER OR OVERALL ALIGNMENT



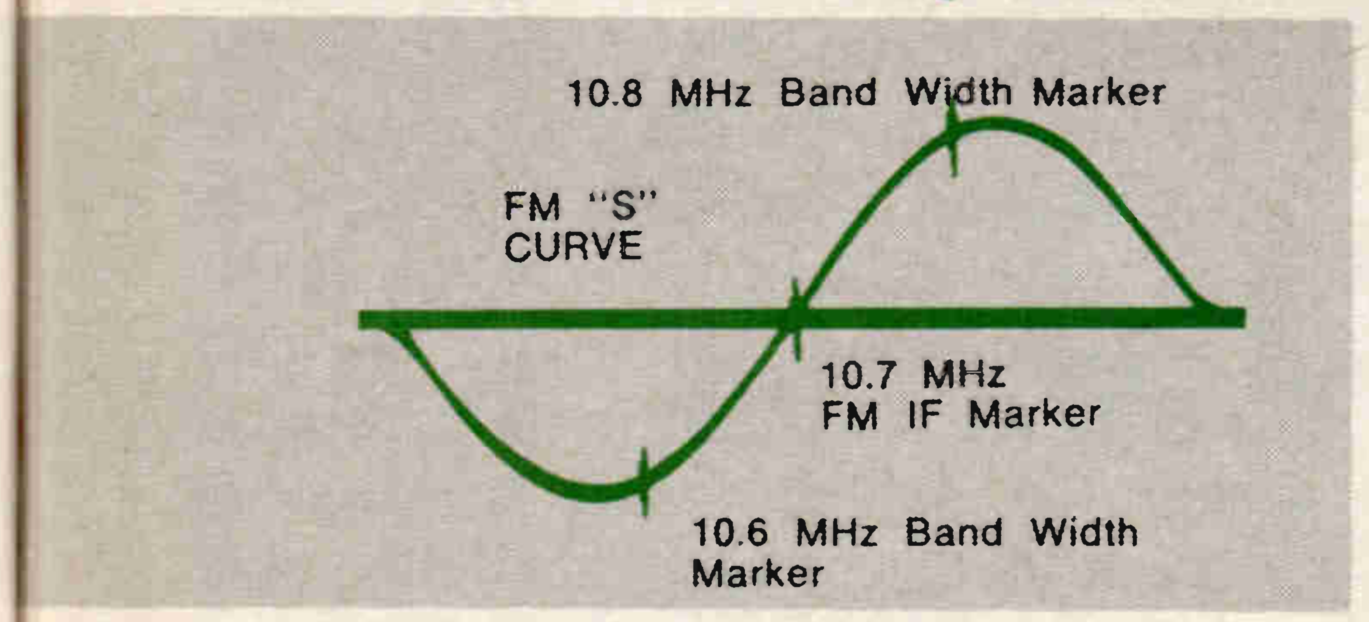
The SM 152 sweeps all of the VHF channels for complete tuner check from channel 2 through 13. Competitive models sweep only two VHF channels. Push button markers are provided for channels 4, 5, 10 and 13 for both the video carrier and the sound carrier. The second low and high channels are available in case you have a station operating on the same channel . . . which will cause the patterns to be upset. You want to align on an unused channel and check it on the channel in operation for best results. Only Sencore goes all the way.

complete UHF SWEEP FROM CHANNEL 14 THROUGH 82



After completely aligning a TV set, you'll want a complete check on the UHF tuner to be sure that it is operating on all channels. Markers aren't necessary as you just view the RF or over-all curve to see that the curve looks the same as the VHF and output remains reasonably constant. Only Sencore has UHF output; all new tuners are required to cover all UHF channels and you will come up short if you own any other alignment generator than the SM 152. A UHF sweep generally costs hundreds of dollars more.

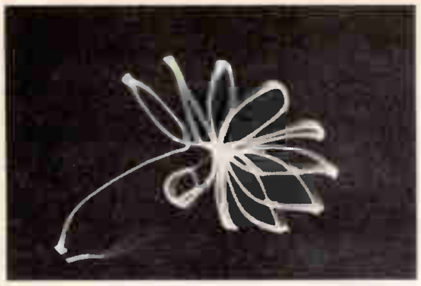
complete FM SWEEP AND CRYSTAL CONTROLLED MARKERS



You won't be stopped with just TV alignment. You can align the IF amplifiers of the FM receivers with the 10.7 MHz crystal for maximum as indicated in service manuals. Then, throw on the scope and sweep the amplifiers and view the "S" curve if you have stereo. Two markers, 100 KHz above and below the 10.7 MHz mark the limits of the curve for good stereo. You can align the front end of the receiver too. Competitive units cover only the IFs and you find the job only half done.

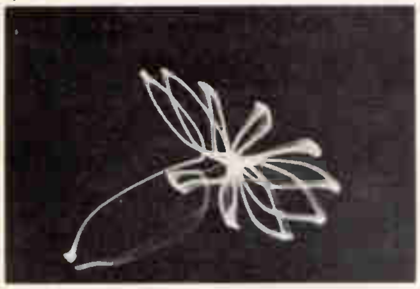
There are other features too numerous to mention that makes the Sencore SM152 the most complete sweep and marker generator on the market. Ultra linear sweep from 10 MHz to 920 MHz, exclusive calibrated sweep width that is constant on all channels and RF calibrated output for circuit trouble shooting are only a few of the things that places the SM152 in a class by itself. Dare compare and you'll see your distributor today for a good look at the SM152.

Circle 19 on literature card

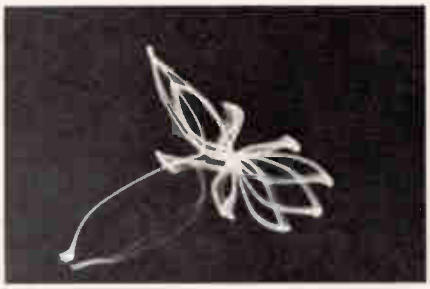


(A) Normal vector pattern with the third "petal" at 90°.

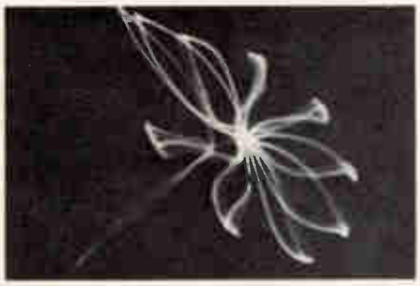
Slide the ATC switch to the FULL correction position. The preference control (with other controls on the back near the top) should change skin hues from greenish-yellow to magenta. If only magenta skin hues are seen, the Red gate may be defective; conversely, if the skin colors are greenish-yellow, the Yellow gate may not be working.



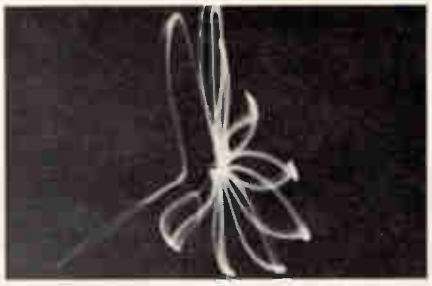
(B) ATC switch in PARTIAL position pulls the first and third petals nearer to bar two.



(D) FULL correction with the preference control adjusted for yellow faces.



(C) With the ATC switch in the FULL position, the first three petals are all at 57° (orange).



(E) FULL correction with the preference control adjusted for magenta faces.

Fig. 8 Vector waveforms of color bars.

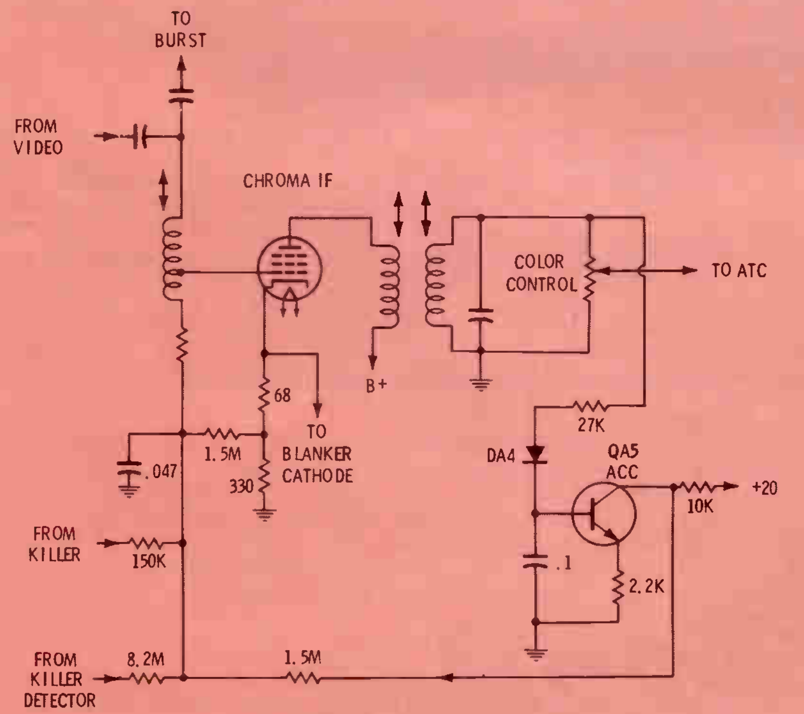


Fig. 9 Simplified schematic of the T940 ACC circuit. ACC is proportional to both burst level and chroma amplitude.

Defects in the gate circuits are best checked in the shop using voltage and waveform analysis to find the defective component. Use a gated-rainbow bar pattern and check for scope waveforms similar to those in Fig. 5.

Loss of the 3.58-MHz switching signal or an open or shorted QA1 switching transistor will eliminate any change in the color hues as the preference control is adjusted through its range. An open switch transistor will eliminate all gate action, and there will be no change in the color when either the preference or the ATC switch is adjusted. A shorted switch transistor will allow both gates to conduct at all times; the preference control will have no effect, but switching the ATC on FULL will brighten all ten color bars. A loss of 3.58-MHz signal to the switching transistor will give the same symptoms as an open transistor.

Conclusion

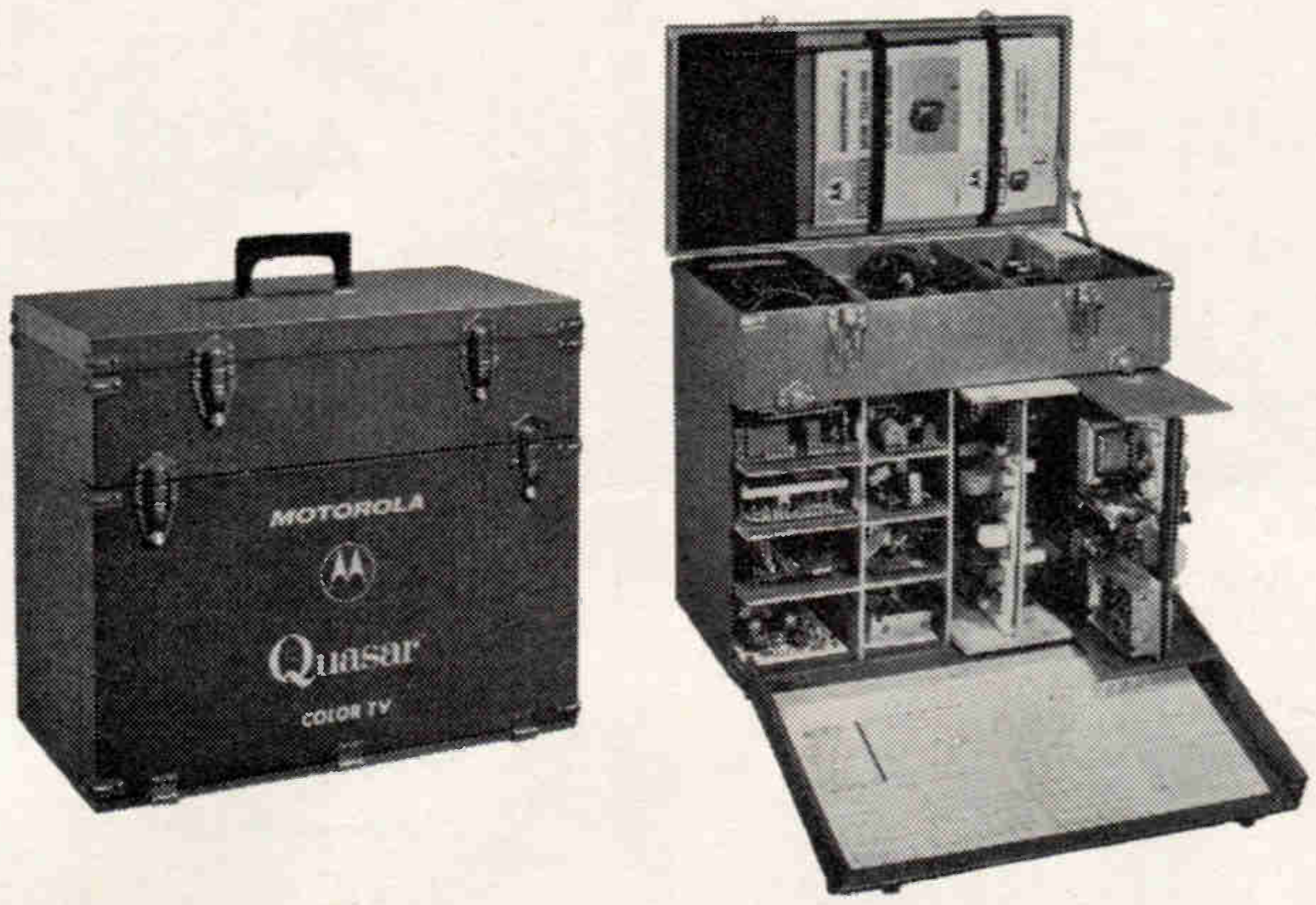
The Magnavox ATC circuit actually functions precisely as explained here. The action is strictly by phase changes (with a minor amplitude side-effect) and, therefore, is instantaneous in action without time lag, locking or registration effects. There are no adjustments to be made on the board, so it is not necessary to "tune-up" anything. When you are accustomed to the sight of one (never more than two) completely red bar on a gated-rainbow color display, it gives one a peculiar feeling to see four (sometimes nearly five) reddish-orange bars on the screen. Obviously, it is four times less critical of skin color than an uncorrected signal.

One small drawback is inherent in this type of phase correction: red becomes orange and greenish-yellow becomes orange regardless of whether these hues are applied to a face or some other object in the picture. This is the reason for the FULL and PARTIAL positions on the ATC switch. Usually the PARTIAL correction would be used where the variation in skin color is not too extreme. Any change in areas of the picture other than skin hues would be minimized.

All factors considered, this ATC circuit is a fascinating addition to modern color TV engineering. ▲

What can the works in a drawer mean to you?

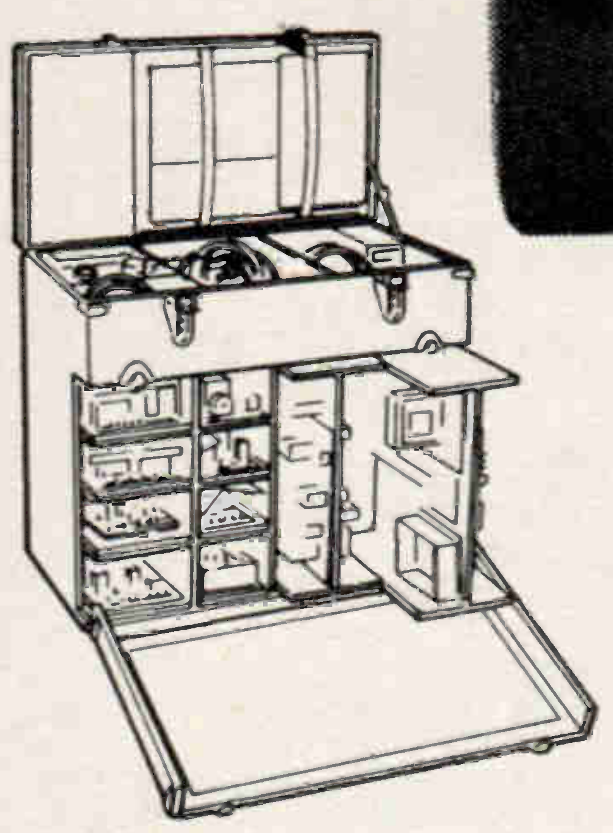
Carry one panel caddy no bigger than a tube caddy



instead of

loading your parts department into a panel truck.

Quasar Color TV's works are plug-in solid-state mini-circuits that fit in a drawer. So, all the at-home replaceable mini-circuits you'll need can be carried in one panel caddy that's no bigger than a tube caddy.



All the reference materials you need to service Quasar Color TV are found in this panel caddy. If you feel you need additional information, call your distributor and he will set up training sessions.

Quasar™ Color TV

with the works in a drawer

by MOTOROLA®

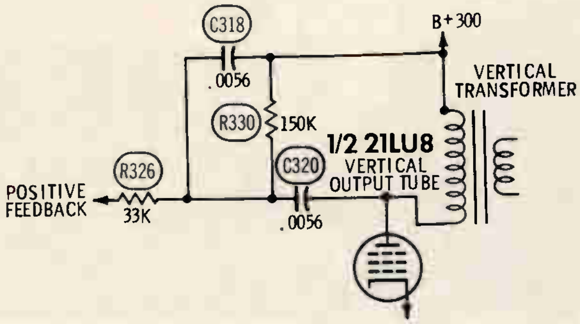
designed to help the professional be more professional

Circle 20 on literature card

symcure

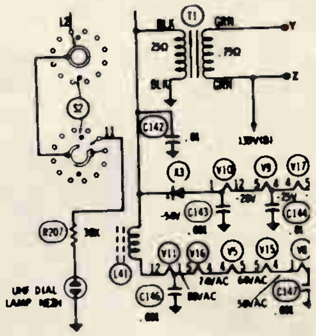
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Sylvania DO5-15
PHOTOFACT folder—905-3



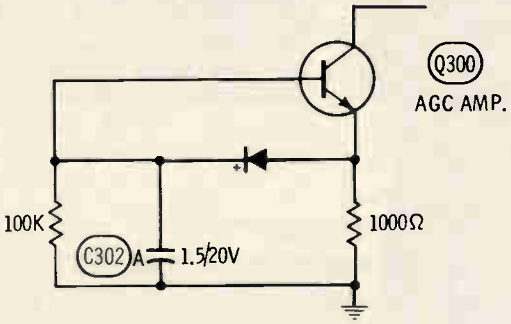
Symptom—vertical roll and shrink
Cure—replace leaky C318

Chassis—Sylvania DO5
PHOTOFACT folder—905-3



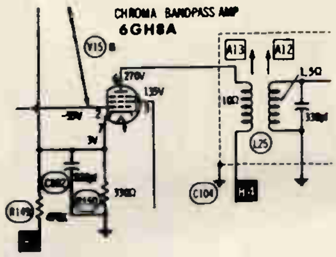
Symptom—repeated burnout of 42KN6
Cure—replace shorted X3

Chassis—Sylvania D12
PHOTOFACT folder—972 POM



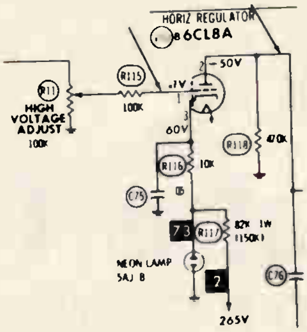
Symptom—picture left side light, right side dark
Cure—replace C302A (1.5/20V AGC bypass)

Chassis—Sylvania DO5
PHOTOFACT folder—905-3



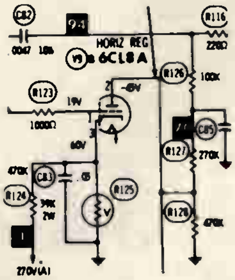
Symptom—very low brightness and no color
Cure—replace R150 in cathode of bandpass amplifier, V15

Chassis—Sylvania DO3
PHOTOFACT folder—842-4



Symptom—no high-voltage
Cure—replace shorted C75

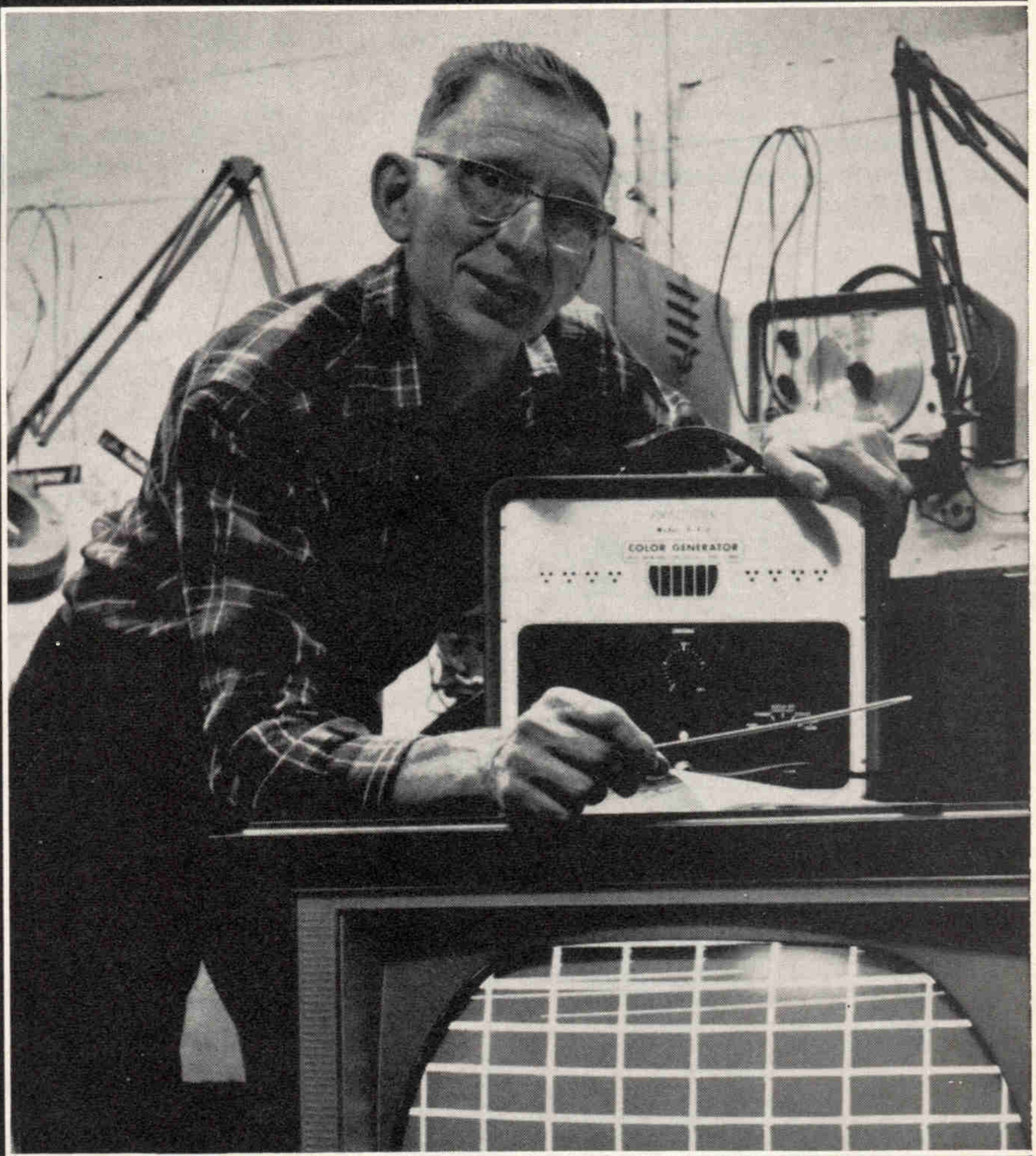
Chassis—Sylvania DO5
PHOTOFACT folder—905-3



Symptom—excessive width and high voltage
Cure—replace R125 in cathode circuit of high-voltage regulator

(Continued on page 40)

"The Yellow Pages is my top salesman."



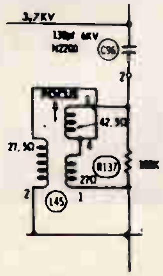
"Most of our customers come to us in one of two ways; either from word-of-mouth, or the Yellow Pages," says Mr. Irwin Grim, owner, Oak Lawn TV Service Center, Oak Lawn, Illinois. "Our Yellow Pages ad is there 24 hours a day working for us. We're an authorized dealer for Motorola and Zenith. In one particular instance, a man called me up and asked me what model television I had on the floor. I happened to have a 23″ console and he asked me to bring it right over. As a result of this one sale, we got about five or six new customers. That's what the Yellow Pages and word-of-mouth advertising working together can do. Our ad also tells people looking for repairs that we've been in business 22 years. It helps give a customer confidence in us. Without our Yellow Pages ad, we couldn't exist. It's what is keeping us in business."

Yellow Pages

An effective way to build business.

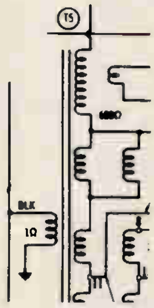
 (Continued from page 38)

Chassis—Sylvania DO6
PHOTOFACT folder—922-3



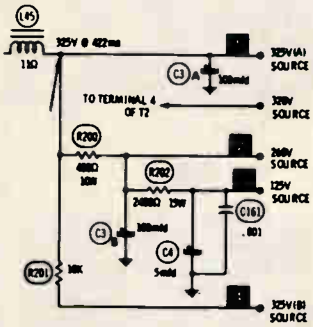
Symptom—green vertical bars
Cure—R137 across focus coil open

Chassis—Sylvania DO6
PHOTOFACT folder—922-3



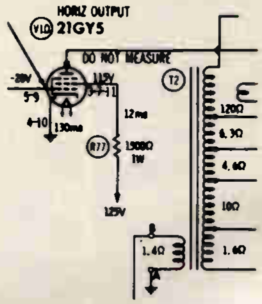
Symptom—no control over brightness, overload and poor convergence
Cure—Repair or replace flyback, open pulse winding T5

Chassis—Olympic CT910
PHOTOFACT folder—918-1



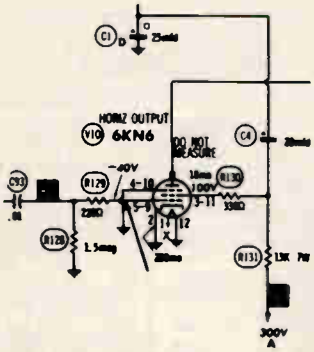
Symptom—blank raster—no picture, no sound
Cure—replace open R202

Chassis—Emerson 11P50
PHOTOFACT folder—950-3



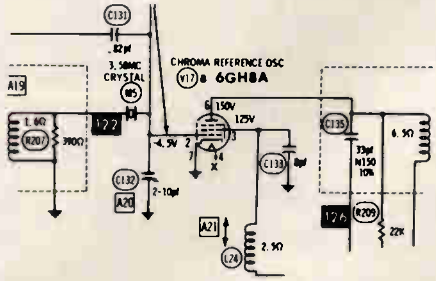
Symptom—intermittent high voltage
Cure—replace R77 (1.5K, 1 watt)

Chassis—Sylvania DO6-1
PHOTOFACT folder—922-3



Symptom—narrow raster
Cure—replace C4

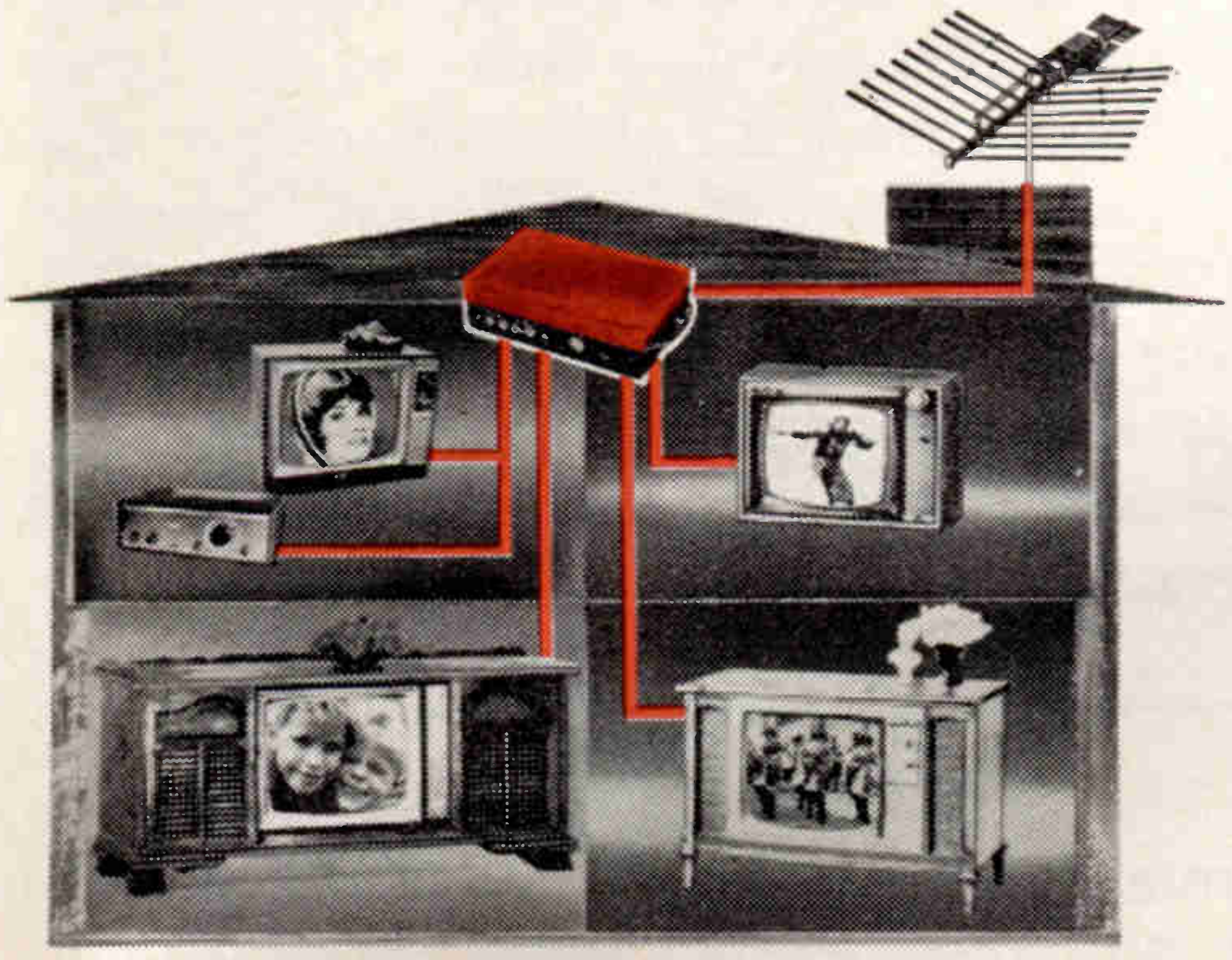
Chassis—RCA CTC31
PHOTOFACT folder—928-3



Symptom—Dim vertical lines in the color
Cure—Replace M5, the 3.58-MHz crystal

JFD is ready!...20 million homes are ready!...
Get ready...get set...go with new

JFD® Home Entertainment Program Center Kits



- ★ Provide up to 4 TV sets with *different* programs — from 1 antenna.
- ★ Beautifully packaged in *full-color carry-home* display carton.
- ★ Distribution amplifier powerful enough to drive up to 12 sets — with additional splitters.

Whether you install it yourself or sell it over-the-counter, the unique JFD Home Entertainment Program Center Kit gets you in on the ground floor of a lucrative new untapped market — 20 million households with two or more sets that can use a distribution system.

Make every home an entertainment center!

Thousands of *old* home owners, *new* home owners, contractors, and builders in *your* area are *ready-to-buy* prospects for (4) JFD Program Center Kits

Easy to sell!
Easy to install!

SEE YOUR DISTRIBUTOR
OR WRITE FOR OUR PROMOTION KIT

JFD ELECTRONICS CORP.
SUBSIDIARY OF RIKER-MAXSON CORP.
15 AVENUE AT 62 STREET, BROOKLYN, NEW YORK 11219
JFD INTERNATIONAL, 2200 SHAMES DRIVE, WESTBURY, N.Y. 11590 / JFD CANADA LTD., ONTARIO, CANADA
JFD DE VENEZUELA, S.A., AVENIDA LOS HATICOS 125-97; MARACAIBO, VENEZUELA

Circle 48 on literature card

NATESA

Convention Report

by Wendall Burns

Inter-Dependent Shops Offering 'Total Service' Proposed as Way to Respond to Industry Problems	*Updating Journeymen Technicians, Better Vocational Programs, Better Image, New Designs—Other Familiar Themes Discussed*

■ The electronic service technician, now doing business as an independent, should unite his day-to-day operations with other independents to form an inter-dependent business structure.

This proposal was made by Frank Moch, NATESA's executive director, in his keynote talk to the convention which was held at the Pick-Congress Hotel in Chicago, Aug. 14-17.

Moch described as primary objectives of the plan he has mapped out:

Survival of the small, privately-owned service shops through cooperation in providing "total service" of all electronic consumer products in a home by one servicing agency.

Each participating shop proprietor would solicit business from the consumer. This service could be obtained on a contract basis if the consumer desired. The shop proprietor would refer to a central agency any calls for service that he could not perform. In return, he would receive calls from the central agency to service products and jobs in which he specializes.

The plan would depend on cataloguing of talents of all participating electronic service technicians in an area according to specialty of each technician or shop.

A service shop that performed service in response to a referred call would do it in the name of the firm that originally received the call. The customer would continue to identify with the firm he originally called, and that firm would not "lose" the customer because another shop performed the job, Moch said. Also, each shop would determine its own schedule of charges for labor and parts.

There is already a certain amount of referral business between independents on an informal basis. What Moch proposes to do is to organize the informal practice of referrals into a formal business structure. Participating shops would use standardized procedures.

The independent is being forced to seek new business structures, Moch said, because of extended warranty and other practices of the manufacturers.

"The extended warranty is depriving the service man of profits on parts. We are now suddenly being confronted with the necessity of increasing rates. And, we are being forced from color service, a thing many had looked to as a bonanza," Moch says. "We recognize that the way of life we have known is ending."

He said that total electronic service to the consumer by a local shop would help the small shop to survive. But, no one shop can be prepared to service the wide variety of consumer electronic goods found in the modern home.

The initial steps have been taken to institute a pilot project in Chicago for such an inter-dependent agency of technicians, according to the NATESA executive.

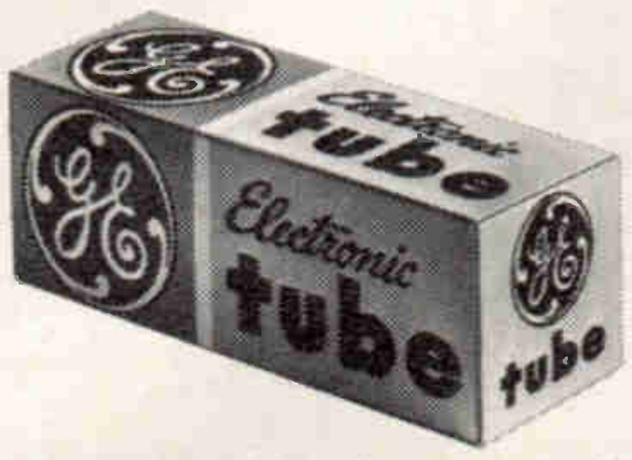
The concept of offering a total electronic service to the consumer by a federation of independents is not new, Moch said, but the business climate was not right for it before. Now, he believes the climate is right because of changes in the overall industry. These changes include more and more sophisticated electronic products and the manufacturers' policies on warranty, parts and service.

A speaker on the subject of better business practices told fellow Natesans that the expression 'secret of success' does not apply to this business. "There is no 'secret of success.' The facts of making money can be stated quite plainly," said this speaker, Joseph Rufo, Holyoke, Mass. Rufo demonstrated how to calcu-

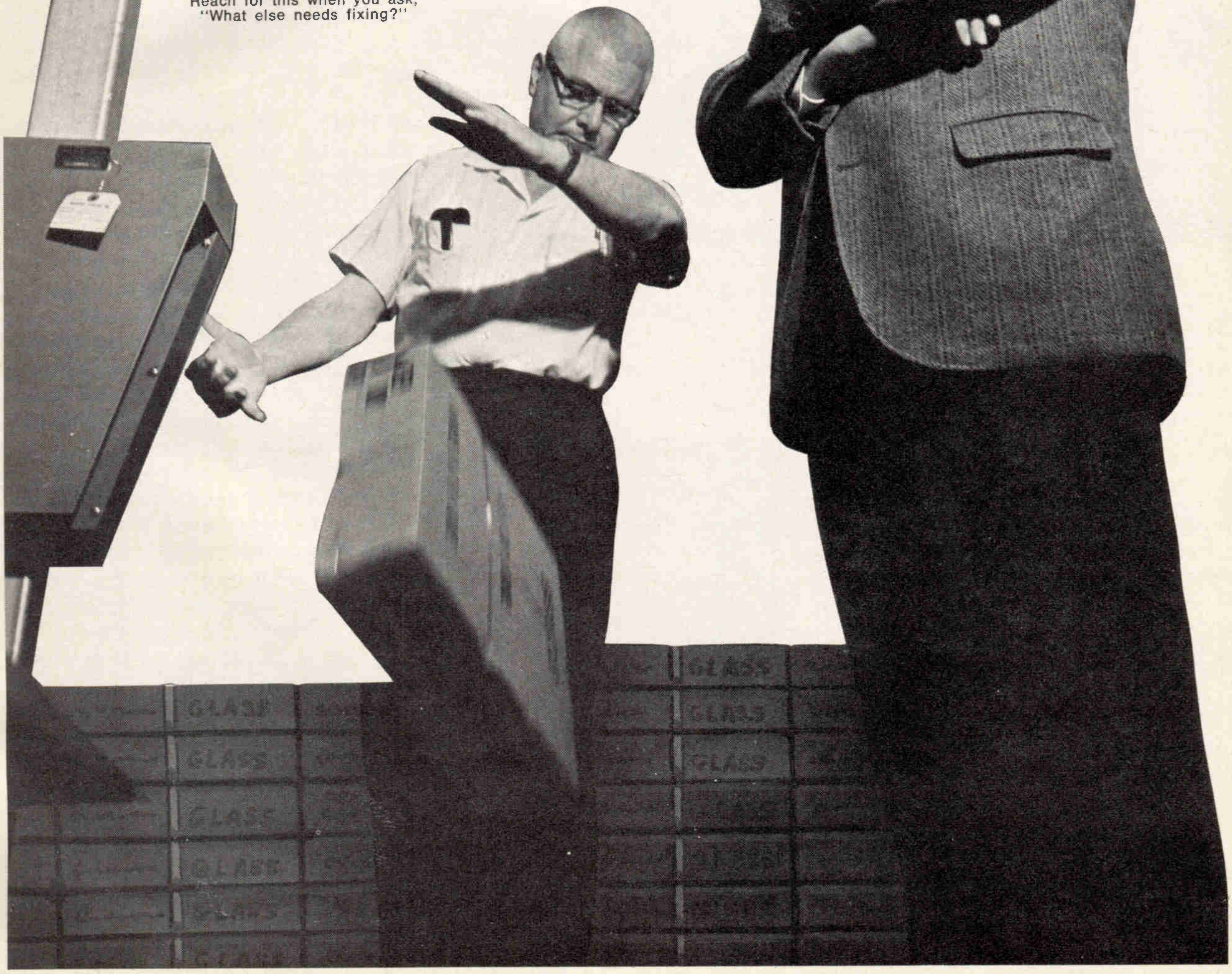
GE tube protection must satisfy these tough customers before they'll ship to you!

General Electric tubes get to you in original factory condition, because inspectors like Ken Omer are real *tough customers* when it comes to giving packaging the once-over. For example, machines with a lighter-than-a-feather touch fill each unit tube carton. Corrugated containers are built to rigid government specifications. Tubes, cartons and containers must pass the "rough handling" test—a dead drop to a solid surface on all eight corners! Unpacked, then tested, only 100% tube operation is good enough. After all, only 100% operation will satisfy you and *your* customers. That's why GE builds extra security into tube packaging. You can stake your reputation on dependable, high-performance GE tubes — the "service designed" line for all of your replacement needs. Stock up at your GE distributor today. 288-21

GENERAL ELECTRIC



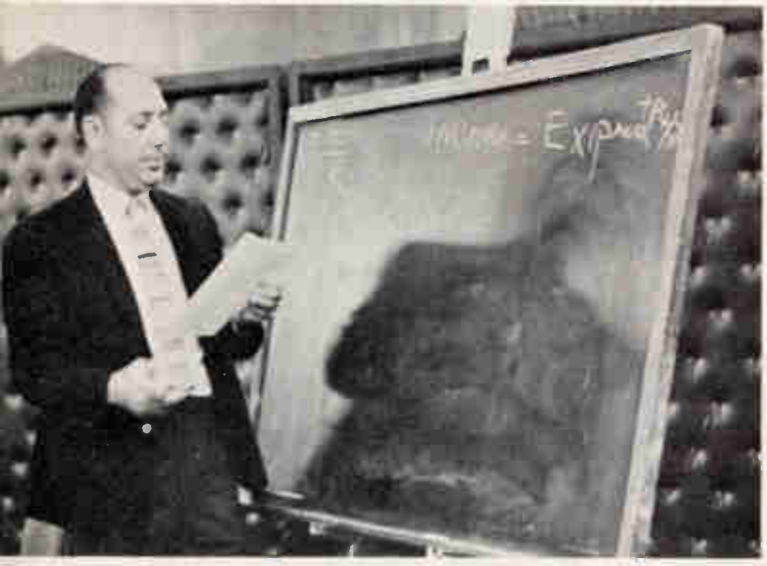
Reach for this when you ask, "What else needs fixing?"



late depreciation on capital investments, how to set a realistic return on investment, how to calculate the cost of doing business, and how to base the charge to the customer on this business data.

He called for establishment of common record-keeping procedures for the industry and calculation of average technician productivity and average service shop operating expenses on both a regional and national basis. Rufo has been self-employed in electronic sales and service for 17 years.

"With extended warranties and more and more solid state—unless we have records to detect these trends—we're going to wind up in trouble and not know why," Rufo said.



Better business management was the topic of Joseph Rufo, Holyoke, Mass., who distributed forms to the delegates asking them to cooperate in a cost-of-doing-business survey.

Speaking of new circuitry is Joe Groves, manager of Sams PHOTOFACT Division.

The subject of updating the journeyman technician and training more new technicians was discussed by John Borlaug, national service manager of Sylvania. He urged the servicing industry to make better use of the technical training facilities and field services offered by manufacturers. He also urged the NATESA delegates to prod their local school boards into offering meaningful courses in electronics that would prepare youth for work. He scorned the tendency of educators and school boards to make high schools almost exclusively college preparatory schools, while neglecting vocational training.

"We are operating a planned program of failures in our school system by sending 80% of the youth to college, but graduating only about 10% of them," he said. "Only 12 percent of the people will be working in professions or management jobs that require college degrees."

Borlaug said that 72.6 percent of young people have indicated in surveys that they want some technical or vocational training. He added that they have little opportunity to obtain this training.

Harold Schulman, vice-president of Dynascan Corp., manufacturer of B&K test equipment, spoke on the need to attract and retain people in the servicing industry. He said it is a problem in other fields as well as in the electronics industry.

"The people in our industry should recognize the need to talk in such a manner so that service will not be down-graded," Schulman said.

On the technical side, Joe Groves, manager of Photofact Division of Howard W. Sams & Co., Inc., provided NATESA delegates with a roundup of the most unique circuit designs included in the new 1970 chassis. He said that new designs will require service technicians to consider new systems of doing bench work.

The subject of the reunification of the members of NATESA and NEA into one association, although apparently not a big issue among delegates at this convention, still appeared to be an issue among the manufacturers. There were some comments on the subject expressed privately. Sylvania's John Borlaug concluded his talk to the Natesans with the identical comment on the subject that he made at the NEA annual convention a month earlier: "We, as manufacturers, can accomplish more by working together in one association (the EIA). We respectfully suggest that you, as leaders of the service industry, could better work by having one association to represent the electronic service fraternity." ▲

test equipment

notes on analysis of test instruments, their operation and applications

In- or Out-of-Circuit Transistor/FET Tester

Sencore has announced the availability of a portable in- or out-of-circuit tester. Performing the same functions as the company's deluxe Model TF151, the Model TF17 is smaller and more compact and features an improved mechanical layout.

The TF17 checks regular transistors in or out of circuit for AC beta, and out of circuit for ICBO leakage. Also, as stated by the manufacturer, it checks all FET's

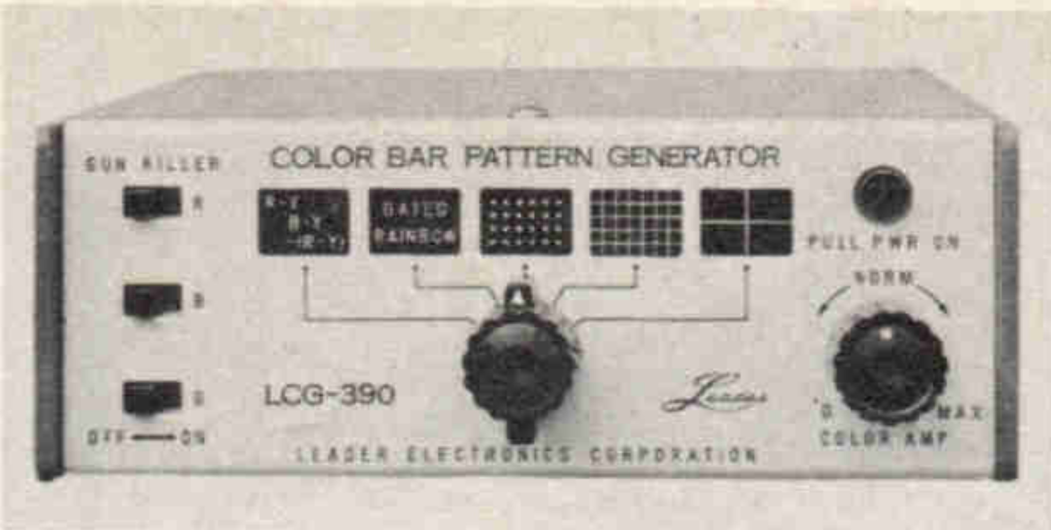
either in or out of circuit for gain, and out of circuit for leakage. It also provides an increased current check for high-power transistors, and a special test for RF transistors.

The instrument is housed in a vinyl-clad steel and brushed aluminum "Handicase" with lead compartment and removable cover. Sencore's reference book, listing over 12,000 transistors and FET's with all information needed for testing them, is included. The price of the Model TF17 is $109.50.

Circle 50 on literature card

Color-Bar/Pattern Generator

Leader Instruments Corp. announces the availability of Model LCG-390 Color-Bar Generator, a compact, solid-state instrument featuring improved stability due to binary counters and gates in the logic circuitry, according to the manufacturer. The patterns generated by this unit reportedly remain completely stationary and show no signs



of flicker, regardless of temperature extremes, line-voltage conditions or transmitter signals.

The instrument is designed as an aid for performing convergence and synchronizing adjustments in color and monochrome TV receivers. It also may be used for linearity checks on TV monitors.

Five basic patterns are displayed: Gated rainbow color bars; R-Y, B-Y and –(R-Y) color bars; well-defined dots; square cross hatch; and single cross centered on the raster. Gun killers are provided for convergence adjustments. The unit has plug-in, computer-style PC boards and a fully regulated power supply. The power requirement is 105-125 volts, 50/60 Hz at 2 VA. The unit measures 2⅛" x 5⅞" x 7¾" and weighs 2.9 lbs. It comes in a scuff-proof carrying case with a shoulder strap.

The price of Model LCG-390 is $119.50.

Circle 51 on literature card

DC Power Supplies

Two new, low-cost, regulated DC power supplies (designated PSR-12) have been announced by **Electro Products Laboratories, Inc.**

They are available in two models: PSR-12-25 with output from 0 to 25V DC, 0 to 500 ma; and PSR-12-50 with output of 0-50V DC, 0 to 250 ma from input of 105 to 125V, 60 Hz. They each weigh 7 lbs. and are priced at $110.00. ▲

Circle 52 on literature card

Technical Sessions to Explain 1970 RCA Line

Product-familiarization meetings to acquaint service technicians and dealers with the technical features of RCA's 1970 consumer electronic products line will be held nationally by RCA Consumer Electronics Distributors during the months of September, October and November. Contact the RCA distributor nearest you for the date, time and location of the meetings in your area.

antenna systems report

Matching Transformer

Developed by JFD Electronics Co., this new 82-Channel matching transformer is designed to match 75-ohm coaxial cable to the 300-ohm inputs of TV and FM sets. Labeled Model MT60, the unit

passes all UHF (14 to 83) and VHF (2 to 13) TV channels plus all FM station frequencies.

An outdoor version of this matching transformer is also available. Designated Model MT61, the unit is supplied with a weatherboot and a snap-on insulator to hold it to the antenna crossarm. This outdoor unit has the same electrical characteristics as the indoor unit.

Model MT60 (indoor) is priced at $2.95 and Model MT61 (outdoor) sells for $3.50.

Circle 53 on literature card

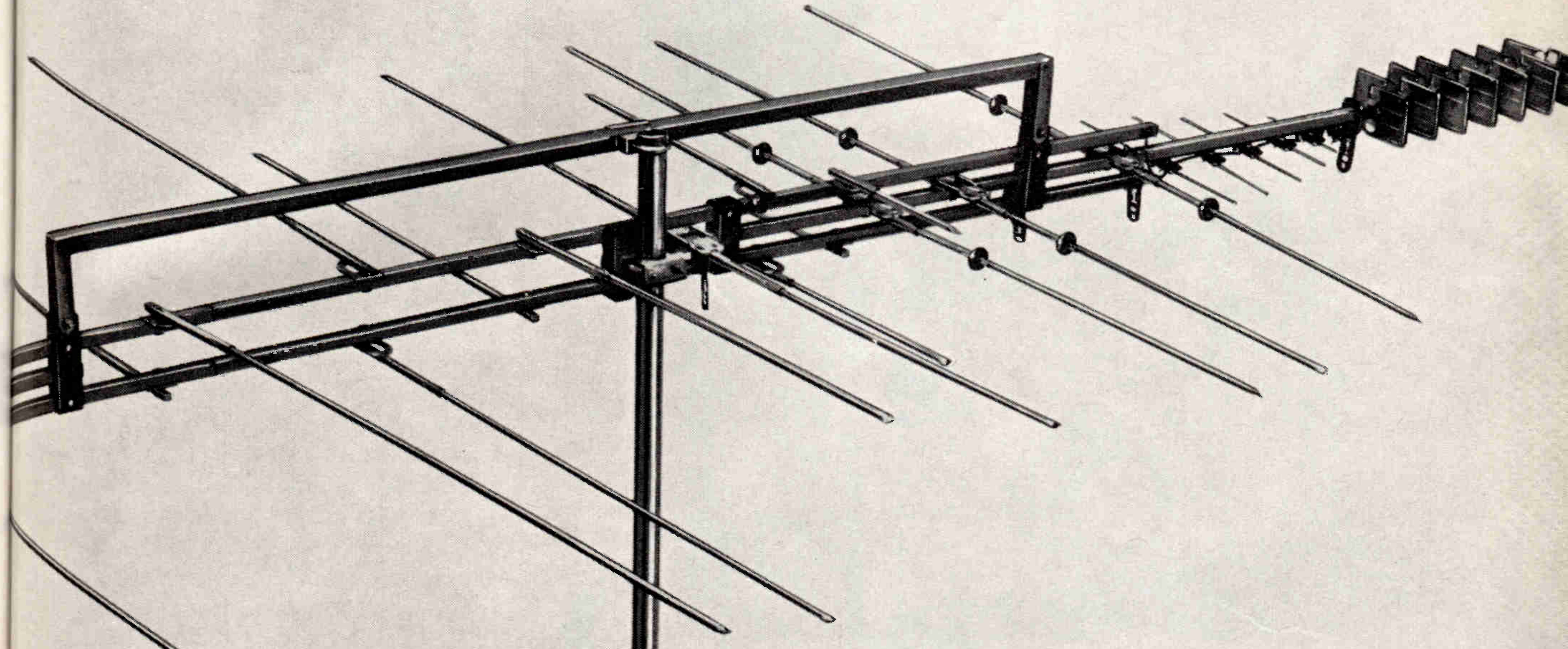
TV Cable Duct

A new adhesive-backed cable duct designed as a raceway system for communications, electronic and CCTV and CATV antenna wiring has been announced by 3M Company.

Called "Scotchflex" brand cable duct No. 807, it provides a channel especially suitable for concealing long runs of RG-59 TV cable. The duct is sold in 4-foot lengths about ¾ inch wide by ⅜ inch high, and is made from ivory-colored PVC.

A strip of 1/32-inch thick, "Scotch-Mount", double-coated, polyurethane foam adhesive permits ducts to be mounted to any

Engineered for outstanding reception– Zenith outdoor antennas for Color TV!



The best color TV deserves the best antenna. And you can recommend and install Zenith antennas with confidence. For every Zenith antenna is electronically engineered for optimum reception in any signal area.

For outstanding performance, Zenith-engineered antennas include:

- Capacitor coupled cap-electronic VHF dipoles.
- Tapered UHF grid driver.
- Staggered square UHF directors.
- Low-impedance, triple boom construction.
- Gold-color alodized coating (to help antennas look better and last longer, with greater corrosion resistance and electrical conductivity).

Your Zenith Distributor has the complete line of Zenith quality-engineered TV antennas and antenna accessories. His staff has the technical experience and knowledge of your area to recommend the best antenna for any installation.

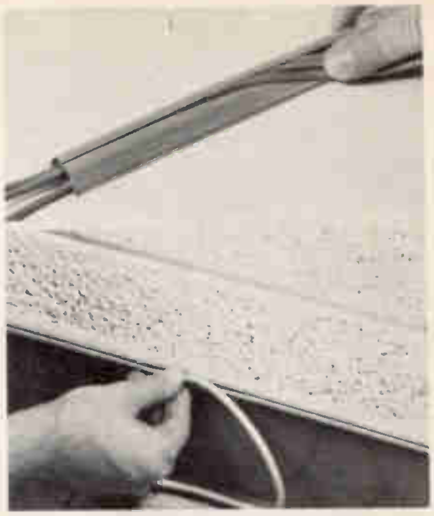
EXCITING SURPRISES FOR YOU—and Your Family!
Get the details at your Zenith *Distributor's Parts Department.*

Why not sell the best

ZENITH®

The quality goes in before the name goes on

Circle 24 on literature card



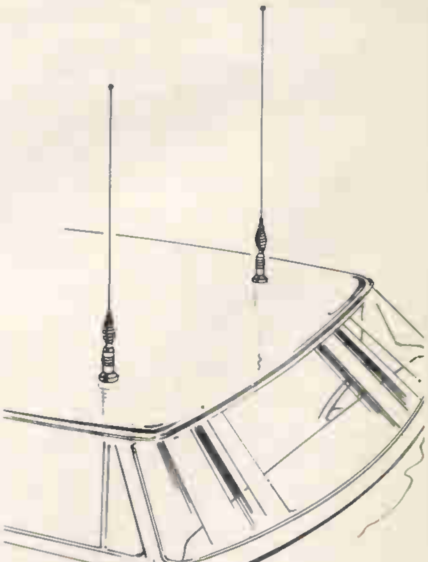
smooth, clean, dry surface without drilling holes or using mounting brackets.

Available in boxes of ten, the ducts cost $1.66 each.

Circle 54 on literature card

Mobile Antenna Co-phasing Harness

A complete co-axial harness system for co-phasing two mobile antennas is now available from Avanti



Research and Development, Inc.

By mounting two mobile antennas on opposite sides of the car (or any other vehicle), a much wider aperture is obtained, thus boosting efficiency 25%, according to the manufacturer. The complete kit includes precision cut cable and coaxial connectors and sells for $6.95. ▲

Circle 55 on literature card

by Allan Dale

Marine SSB Made Simple

A brief but complete explanation of the basic operating principles of SSB communications equipment.

Some technicians who work with Citizens band and two-way radio tell me they don't understand single sideband. That's a shame, because it really isn't complex. There are only three real differences between single-sideband communication gear and ordinary two-way equipment. Yet those differences seem to throw some technicians for a loop.

The transmitter modulator is a special kind called a **balanced modulator.** Its special purpose is to modulate the carrier, but then eliminate it. (The whole name of what we call an SSB signal is **single-sideband-suppressed-carrier** signal.)

Another difference is the receiver detector. The SSB signal, being without a carrier, cannot be demodulated directly. So, a carrier has to be added to the receiver. The product detector adds a carrier and demodulates the signal all at the same time.

The only other **important** difference is in the transmitter power amplifier stage. The relationship of all the components in the sideband signal must be maintained perfectly. The usual class-C power amplifier is out of the question. It generates too much distortion. Instead, a **linear** amplifier is used.

The SSB Signal

First, let me explain what's meant by **single sideband.** I'll start by describing plain amplitude modulation.

Modulation is a process in which an audio signal is mixed with an RF carrier. Any time two signals are mixed together the way these are, in an ordinary modulator, they heterodyne (beat together) and create sums and differences.

Imagine a 1400-KHz signal, modulated by voice frequencies—those between 300 and 3000 Hz. When they are mixed, the sum frequencies range from 1400.3 to 1403.0 KHz. The difference frequencies range from 1397.0 to 1399.7 KHz. You can see these graphically on the spectrum chart in Fig. 1.

These sum and difference frequencies on each side of the carrier are **sidebands.** The signal in Fig. 1 is technically a **double-sideband** signal. You may know it as an amplitude-modulated signal.

The illustration also shows how power is concentrated. About 60% of it goes into the carrier. That leaves only about 20% for each sideband. The sidebands are what actually contain the voice-frequency intelligence. They are the only important part of the signal as far as communication is concerned.

So, why waste 60 watts or so of the power from a 100-watt transmitter in the carrier? All you have to do is get rid of the carrier. That can be done with a special modulator called a **balanced modulator.** A 100-watt transmitter then concentrates 50-watts in each sideband. That makes the sidebands at least 2½ times more powerful.

Carrying the same thinking further, there isn't really any need for both sidebands. One is merely a mirror duplication of the other. Consequently, if you get rid of one of them, the entire 100 watts can be concentrated in the single sideband that remains.

That's what a signal-sideband transmitter does. It modulates the signal in a way that eliminates the carrier, then uses a filter to get rid of one sideband. The output of a 100-watt single-sideband transmitter has as much effective communicating power as the output of a 500-watt transmitter that is transmitting full carrier and both sidebands.

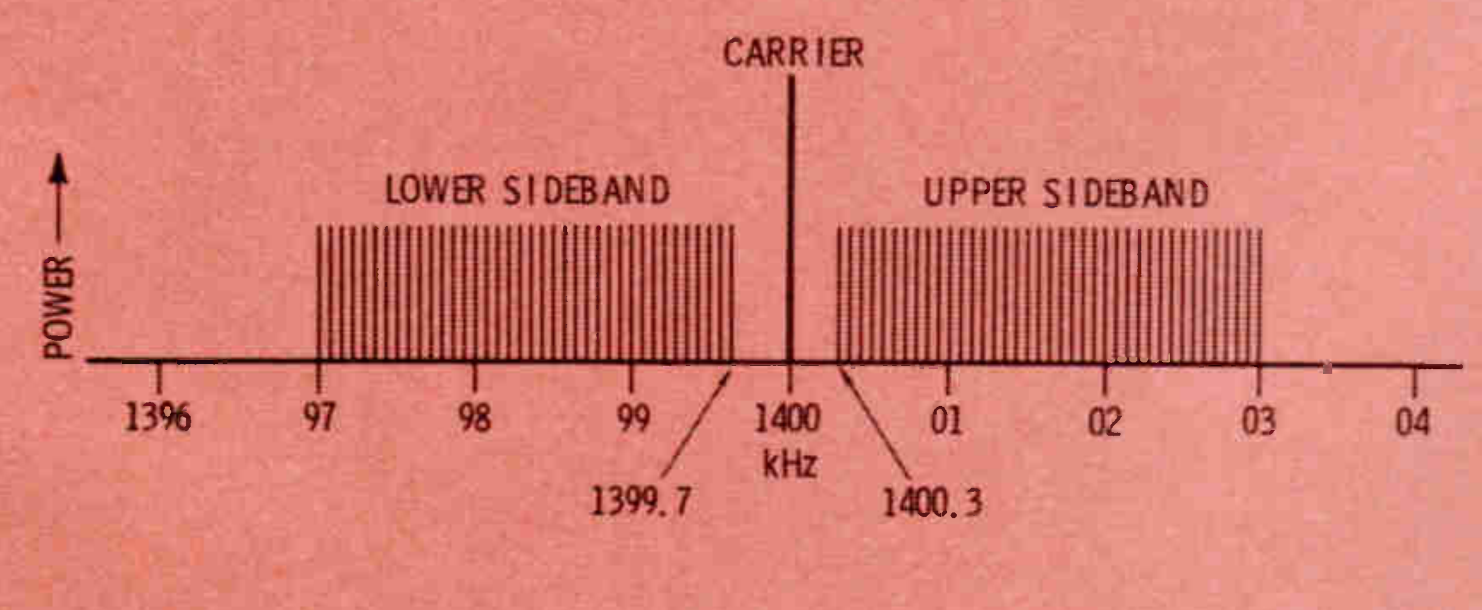


Fig. 1. Spectrum graph shows frequency relationships of carrier and sidebands in ordinary amplitude-modulated signal.

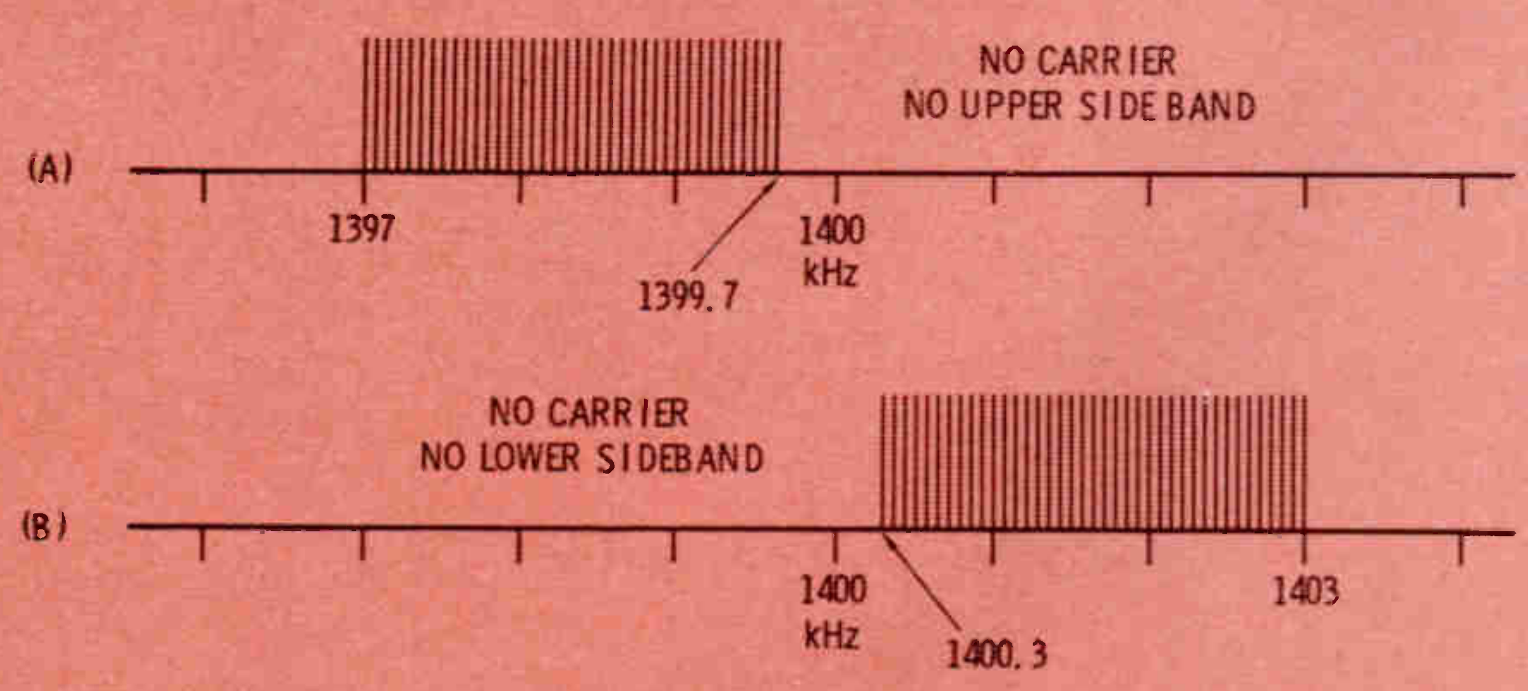


Fig. 2. Output of sideband filter is a single-sideband suppressed-carrier signal. (A) Lower sideband. (B) Upper sideband.

Fig. 2 is a spectrum chart for a single-sideband signal at 1400 KHz. Fig. 2A shows the lower sideband; Fig. 2B shows the upper.

The SSB Transmitter

You can get a more complete idea how the SSB signal is generated from the block diagram in Fig. 3.

The first thing to notice is one important factor about SSB transmitters: The SSB signal almost always is generated at some low frequency. This particular transmitter is in a marine radio-telephone; the "carrier" is generated at 1.4 MHz. Remember, this is not the transmitting or output frequency. That comes later.

The microphone and speech amplifiers are like those in any transmitter. The voice signals are fed to a balanced modulator.

The carrier generator (oscillator) happens to be part of the balanced modulator stage in this unit. In many, the carrier is generated by a separate oscillator. Either way, the carrier is always crystal controlled at one low frequency.

The little spectrum charts in Fig. 3 show the signals developed through the transmitter. The output of the balanced modulator is a double-sideband signal minus the carrier. The sidebands are "centered" on 1.4 MHz (1400 KHz).

The sideband filter eliminates one or the other sideband. The output of the sideband filter in Fig. 3 is an upper sideband "centered" on 1.4 MHz. (If the sideband switch is thrown to its other position, the filter output is a lower sideband.)

Now comes the place where frequency is changed to the transmitter's output frequency. This is done with a **balanced converter,** sometimes called "second balanced modulator" or "balanced mixer." It "heterodynes up," or increases the sideband frequencies, to make them a sideband of whatever output frequency has been chosen. To do this, another oscillator is needed. In this particular transmitter, the **RF oscillator** is crystal controlled, at fixed frequencies between 4.4 and 16.4 MHz. This allows the transmitter to have output frequencies anywhere between 3.0 and 15.0 MHz.

Suppose one output frequency of the transmitter is 10 MHz, or 10,000 KHz. The sideband filter provides voice-intelligence sidebands from 1400.3 to 1403.0 KHz. The RF oscillator must generate a signal of 11,400 KHz.

The balanced converter mixes the two signals in a way that eliminates the 11.4-MHz carrier. The result, then, is a new pair of frequency bands that correspond in voice-intelligence characteristics to the original sidebands. The big difference is that they are at much higher frequencies. The sideband signal that is the **sum** output of the balanced converter is from 12,800.3 to 12,803.0 KHz. The sideband signal that is the **difference** output of the converter is from 9997.0 to 9999.7 KHz. The latter is the voice-frequency sideband just below (lower sideband of) 10 MHz.

The RF circuits and stages that follow the balanced converter are tuned to 10 MHz. They pass the 10-MHz lower sideband quite readily. However, they completely reject the 12-MHz-plus signals that are generated as the **sum** heterodyne. From there on, the transmitter looks like any other. There's an RF amplifier, a driver, and a power amplifier. Later, I'll describe the special nature of the power amplifier.

Sometimes, the converter is not a balanced type. In those cases, its output contains the RF-oscillator signal as well as the "new" sidebands. The balanced configuration gives a much cleaner output, especially when the output frequencies are comparatively near the carrier-generation frequency.

In VHF transmitters that use SSB, the RF oscillator may be followed by a multiplier stage before the signal is applied to the converter. Or, a second stage of conversion may be added. In a few brands, you may find converters called second or third modulators.

Receiving Single-Sideband

If you study the diagram in Fig. 4, you'll see that receiving an SSB signal is remarkably close to the exact opposite of generating one.

The incoming lower sideband of 10 MHz is amplified and applied to a simple mixer stage. When the receiver is set to receive a 10-MHz

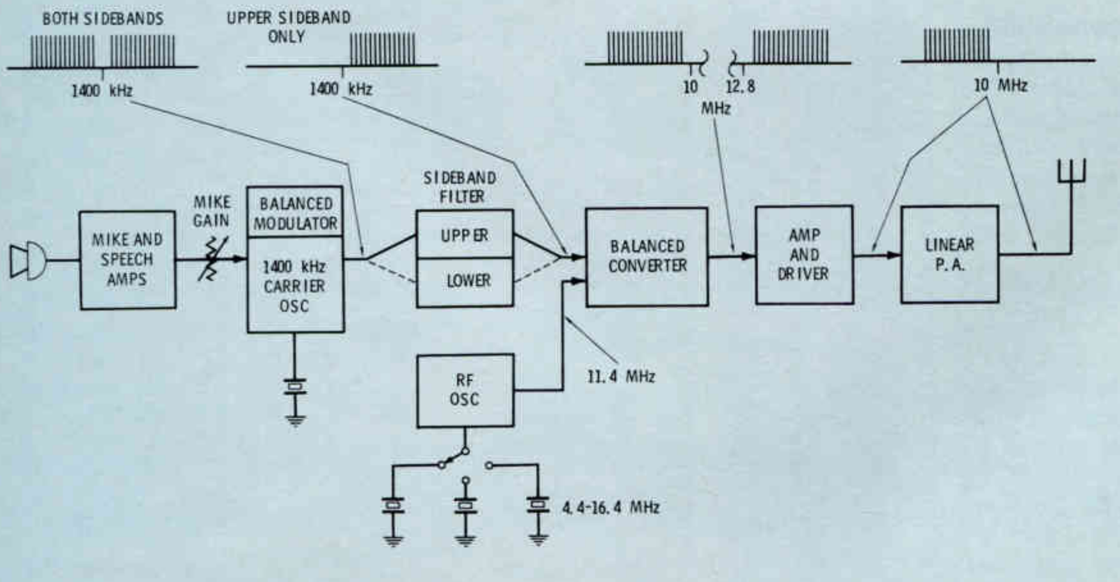


Fig. 3. Transmitter for SSB generates sideband at low frequency and heterodynes it up to the chosen output frequency.

SSB signal, it uses the same crystal-controlled 11.4-MHz signal used in the transmitter for convering the sideband to the output frequency. This 11.4-MHz signal is fed to an ordinary mixer stage along with the 9997.0-9999.7 KHz sideband signal. As you'd expect, the mixer output contains, in addition to the two input signals, the sum and the difference of the two.

The difference signal is the only one we are interested in. It figures out to be a 1400.3-1403.0-KHz sideband, like the one generated back in the transmitter. The original signals and the sum signal are far removed from that frequency. The mixer output is passed through a filter that rejects all frequencies except that sideband. In fact, the sideband filter used in the transmitter has exactly the bandpass needed, so it is used in the receiver. This upper sideband of 1400 KHz is amplified in a pair of IF stages, and then fed to the product detector stage.

For the voice modulation to be removed, the sideband signals need something to "beat against." A sideband of 1400 KHz requires a 1400-KHz signal. That signal is obtained from the same oscillator that generates the carrier in the transmitter. (This "double" use of stages is common in SSB equipment because it is so handy and economical.)

The product detector is just a form of mixer for the two signals. The difference frequencies that result are voice signals—the original modulation. The SSB signal has been demodulated. The audio stages that follow are the same as in any other receiver.

That's all there is to transmitting and receiving single sideband. Now, to fill out your knowledge of the system, I'll tell you more about two stages that are so different from their counterparts in ordinary transmitters and receivers. These are the balanced modulator and the linear power amplifier.

The Balanced Modulator

What a balanced modulator does, I've already described. How it does it is a little more difficult to explain.

Imagine a signal fed to two identical stages in parallel. If the output is taken from the stages in push-pull, the positive excursions of the cycle cancel the negative excursions. However, a signal fed to the same stages in push-pull and then taken off in push-pull shows up in the output.

Now suppose these identical (balanced) stages are **modulators.** The carrier is fed to the balanced modulator stages in parallel, while the voice signals are fed push-pull. The output is push-pull. Only the sidebands show up in the output. The carrier itself is canceled, just as it would be without the voice modulation.

Fig. 5 is a stage that does all this and more too. In some SSB transmitters, the carrier generator is a separate oscillator. In this model, one tube serves as both oscillator and balanced modulator. This special tube is the RCA 7360.

Notice its structure. It has a cathode, a control grid, and a screen grid. In that respect it's like any other tetrode. However, there are two plates. Between the screen grid and the two plates are a pair of elements called **beam-deflection electrodes.**

Electrons leaving the cathode are accellerated into a rather thick beam by the regulated B+ applied to the screen. The two plates, which also are connected to highly positive voltages, divide the electrons into two beams. The deflection electrodes help focus the beams. A voltage applied more to one than to the other also can pull the beams aside, so that they "miss" the plates. An audio signal can deflect the beams back and forth at an audio rate. That in effect, as far as the output is concerned, "modulates" the beams with the audio signal.

Now concentrate for a moment on the components connected to the cathode and grid. One is a 1400-KHz crystal. It's connected to make this "triode" section of the tube into a crystal-grid oscillator. It generates the carrier for this transmitter.

The crystal tolerance may not be precise enough for SSB carrier generation. To correct any error, a variable-capacitance (varactor) diode is connected between the grid and the cathode load. In series with C1 and C2, its capacitance "warps" the crystal to exactly 1400 KHz.

The varactor diode is self-biased slightly by resistor R4. A positive

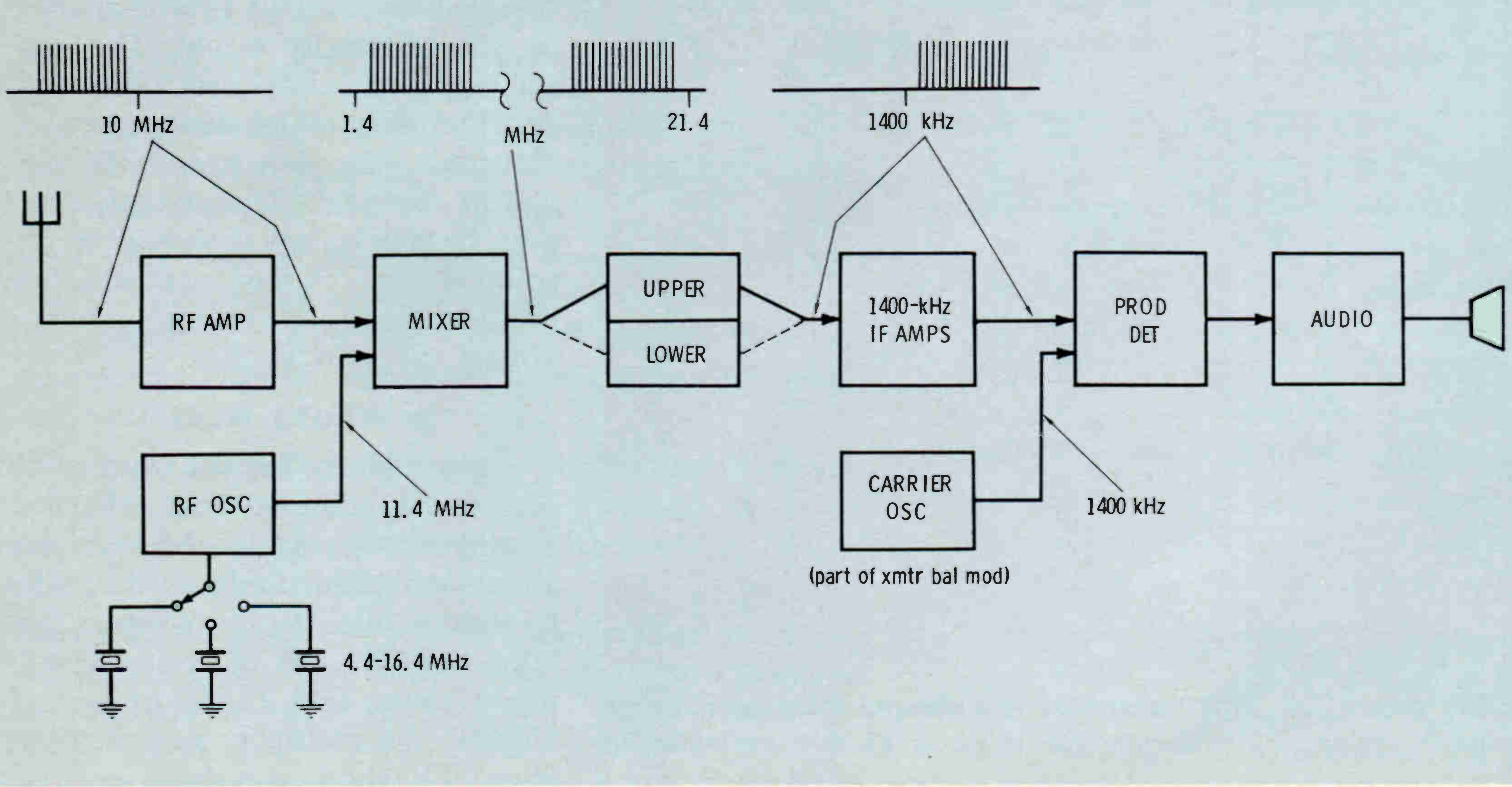


Fig. 4. Receiver bears resemblance to transmitter hooked up backward. Double conversion is used, and special detector.

voltage is applied to its cathode by TRIM control R1. Adjusting that potentiometer precisely sets the frequency of the oscillator.

Now consider what is happening in the whole tube. Both beams drawn toward the plates are modulated by the 1400-KHz oscillator signal in the grid circuit. Besides that, they are swung from side to side by the audio signal applied to the deflection electrodes.

There you have the operating conditions for a balanced modulator: RF input in parallel and audio input in push-pull, with output (to T1) in push-pull. So, the 1400-KHz signal is canceled in the output, while the modulation sums and differences (the sidebands) remain. They are coupled by transformer T1 to the sideband filter.

There are three adjustments. One is the **Trim** control already described; you adjust it to produce a precisely accurate signal at 1400 KHz.

The second is labeled **Quadrature Balance.** It evens up the positive voltages applied to the plates and deflection electrodes on each side. To adjust the quadrature balance control, apply a single tone to the audio input. Adjust the pot for maximum output measured by the RF VTVM connected at the input of the sideband filter.

The **Carrier Balance** network is adjusted with zero audio. Clip a jumper from the audio input to ground during this adjustment. Again, the sensing device is a VTVM with RF probe connected at the sideband filter. With the VTVM set to its most sensitive range, adjust the Carrier Balance trimmer for as near zero signal as you can get. The adjustment balances out the 1400-KHz carrier generated by the oscillator.

The balanced converter uses a similar tube. The main difference is that the input to the converter control grid is from the RF oscillator. The signal fed to the deflection electrodes is the single-sideband signal from the filter. The RF oscillator signal doesn't show up in the output, only the sum and difference sidebands.

Linear Power Amplification

There is no need for a schematic diagram to explain this. The final amplifier circuit in this transmitter is the same as in any other. What is different is the kind of bias used.

Ordinary class-C RF amplifiers develop their own bias. The tube is driven so hard that the grid draws current and develops bias voltage across the grid load resistor, which causes distortion.

In a linear amplifier, for single-sideband operation, **class AB1** bias is used. The grid could draw current on extremely high peaks, but they are avoided. The result is that the only distortion is in the rounding of each cycle. This small amount of distortion is straightened out again in the tuned circuits that follow the power amplifier. There is no upsetting of the relationship among the various frequencies within the sidebands.

Tuning up such a system is simple. You treat it the same as you would a class-C system—except for (usually) a **Bias** control. You generally set it for some specific value of bias on the grid of the power amplifier stage. The manufacturer's instructions can tell you what the value is for the particular tubes used in the final stage of the SSB transmitter you are tuning. For the parallel 6550 tubes used in this set, bias is approximately –40 volts.

If you do decide you need to adjust neutralization, because the output stage tunes erratically or the tube plates seem to overheat, do it as you ordinarily would. The easiest way is to disconnect plate voltage and then watch how much effect tuning the plate has on the voltage at the grid. The change won't ever be much, but it should be absolutely zero. Adjust neutralization until the final-plate tuning no longer affects the grid voltage.

What's Next

Again, thanks for your letters. In response to some of them, what I'm writing about next is FM multiplex alignment, particularly as it applies to automobile stereo receivers. At least half the job of troubleshooting a stereo-FM receiver lies in aligning the multiplex section. Next issue, I'll show you how. ▲

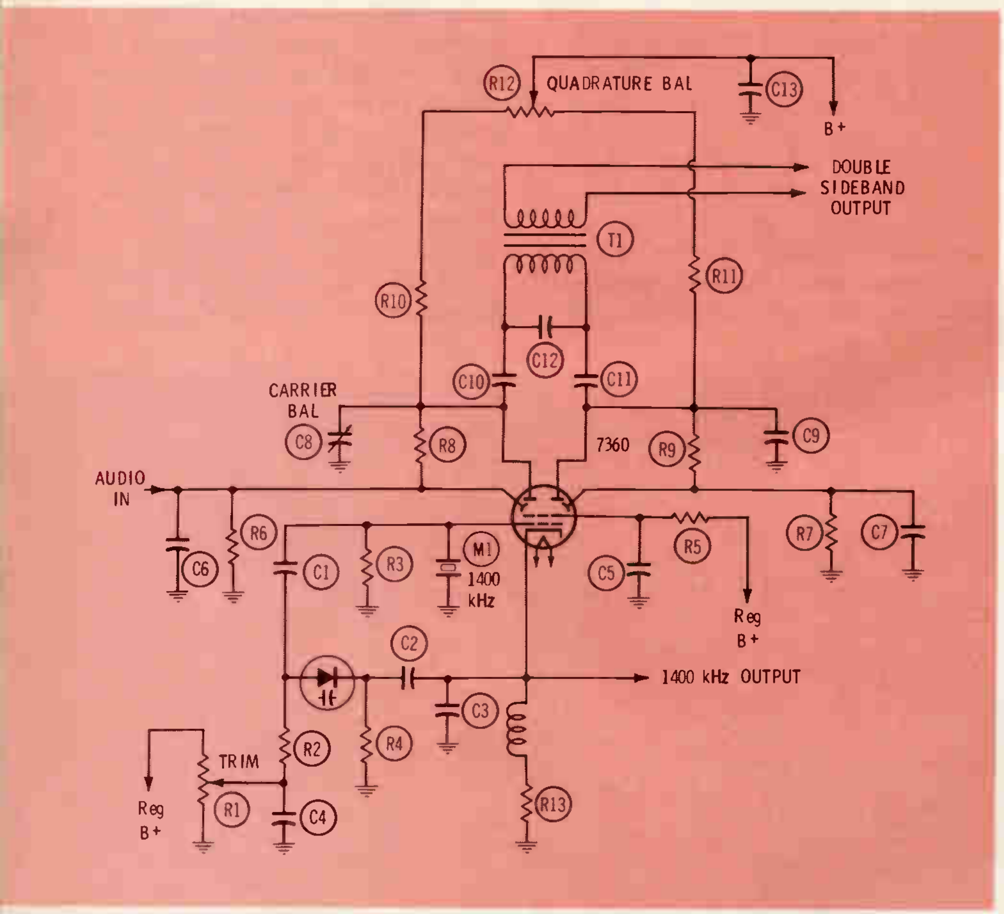
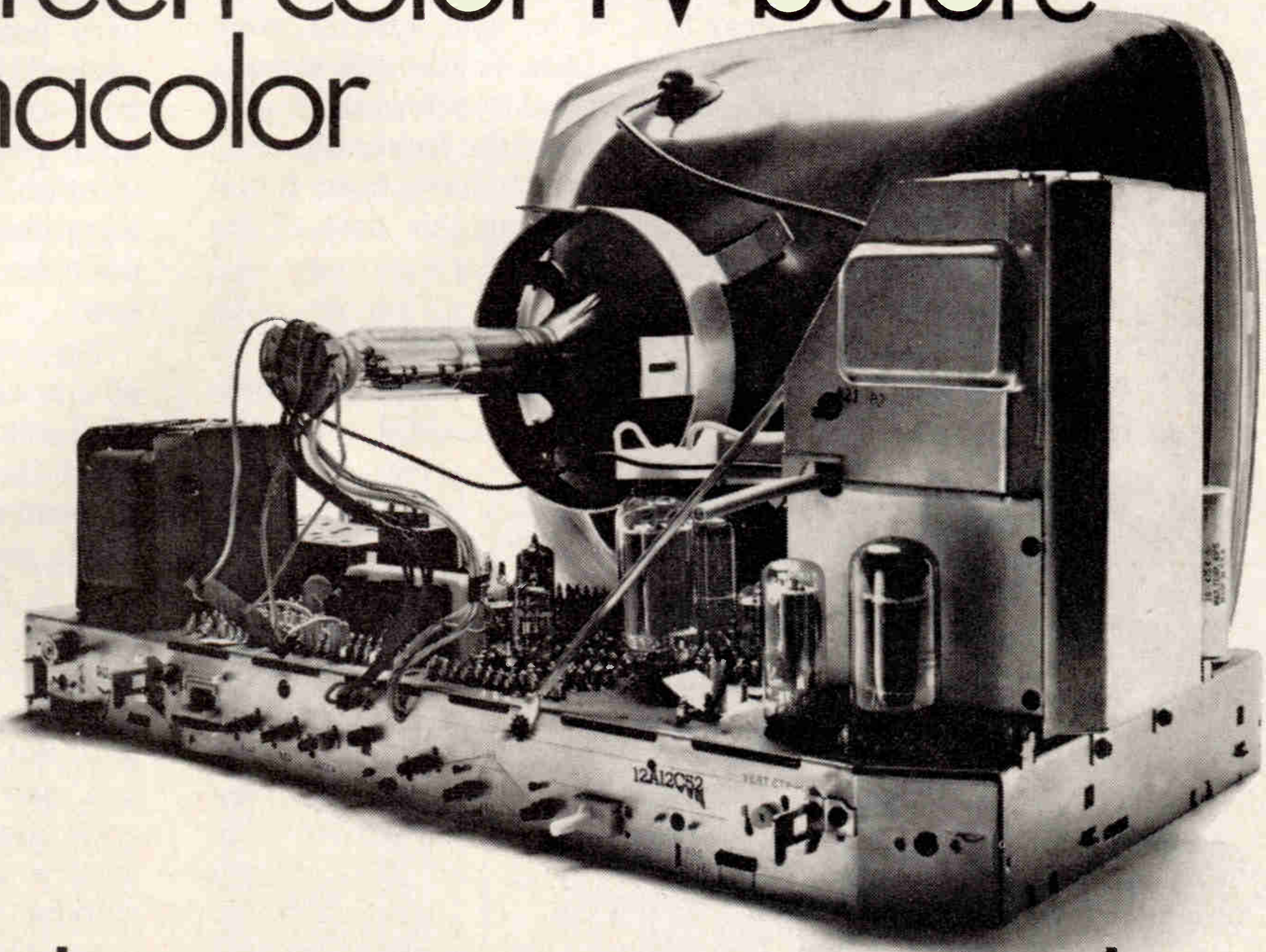


Fig. 5. Most complicated part of an SSB transmitter is balanced modulator. Some models use simpler diode system, but the principle is same as that explained in text.

Zenith's new CHROMACOLOR outcolors...outbrightens...outdetails... and outperforms...every giant-screen color TV before Chromacolor



...and it's the easiest to service!

Zenith Chromacolor is a revolutionary new color television system... featuring a revolutionary new patented color picture tube... pioneered and developed by Zenith.

Five important engineering advances make Zenith Chromacolor the most dependable color TV ever made. And by far the easiest to service.

New Chromacolor Picture Tube uses Zenith's patented black-surround screen and fully illuminates every color dot—for a color picture that's more than 100% brighter, with truer colors, sharper detail, and greater contrast than any giant-screen color TV before Chromacolor.

New Titan Color Chassis combines Handcrafted dependability with solid-state performance. All transistors are either plug-in or part of a plug-in assembly. All test points are flagged or coded for easy identification.

New RGB Color Circuitry is more sophisticated and highly refined—for higher color fidelity. And alignment is simplified for setup and servicing.

New Color Commander Control. Now! *One control* simultaneously adjusts contrast, color level and brightness in proper balance to provide the most pleasing picture for any light conditions in the room! This easy viewer adjustment means fewer false service calls to remedy maladjustments.

Exclusive Chromatic Brain introduces TV's first integrated circuit in a color demodulator . . . for the purest reds, greens, and blues. 100% of the color demodulator circuitry is in the easily accessible plug-in Dura-Module.

Take a good look at new Zenith Chromacolor. Designed with both you and your customer in mind. The best giant-screen color picture! The easiest to service!

ZENITH®
The quality goes in before the name goes on

Circle 26 on literature card

Horizontal Sync Simplified

A detailed examination of the operation and troubleshooting of the horizontal circuitry, from separator to oscillator.

by Bruce Anderson

In a preceding article ("Vertical Sync Simplified," Sept. '69) methods of separating the sync pulses from the composite signal were explained. Some of the requirements of the sync separator, and also some of the problems which may arise in the receiving system but which may appear to be in the sync systems, were discussed. This article will discuss the horizontal synchronizing process and some of the troubleshooting techniques which have been found useful in servicing this part of the television chassis.

Sync Separator

The explanation of sync separators in the article on vertical sync also is valid for this discussion, but one additional circuit is mentioned here because it is incorporated in some designs primarily for the purpose of suppressing the effects of noise pulses on horizontal synchronization. (Because of the heavy integration of the vertical sync pulse, noise is not so apt to affect vertical sync.)

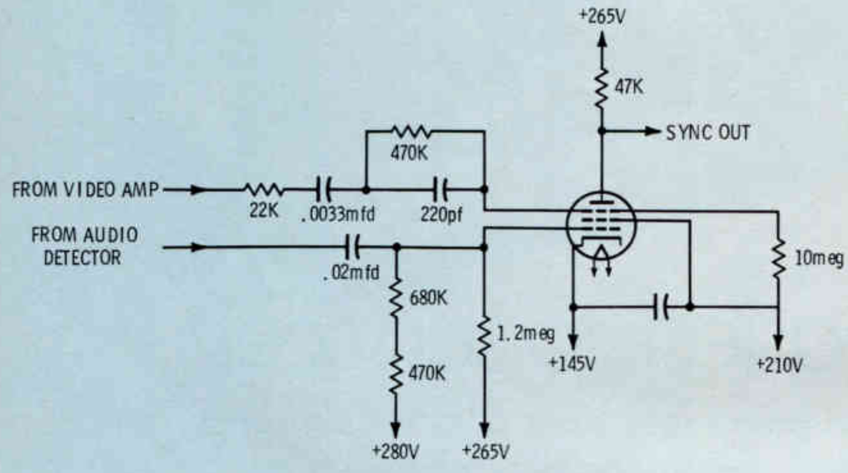


Fig. 1. Simplified noise-immune pentode sync separator.

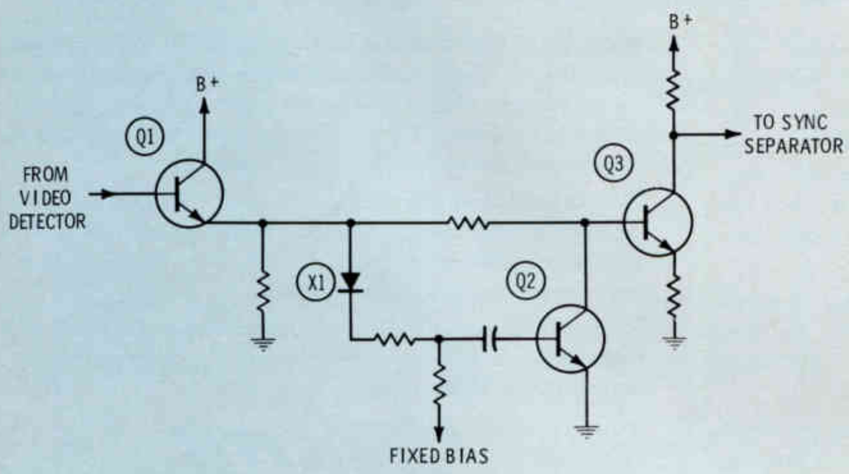


Fig. 2. Simplified solid-state noise-immunity circuit.

Fig. 1 shows a simplified circuit of a noise-cancelling sync separator similar to the one used in the Admiral late-production G13 chassis. A pentode is used instead of the triode normally used for sync separation. The pentode is designed especially for sync separation and AGC keying, and contains a single cathode, control grid, and screen grid, but it has two suppressor grids and two anodes. The suppressor grids are so constructed that they have a considerable effect on the amount of anode current which flows; this type of pentode is sometimes called a dual-control-grid pentode. (The suppressor grid and anode which pertain to the AGC circuit are not shown in the circuit in Fig. 1.)

The input to the suppressor grid is the positive-going composite signal from the plate of the first video amplifier. If only the suppressor grid, cathode, and anode of the tube are considered, the circuit functions in the manner described in the previous article mentioned earlier. When the positive sync pulse drives the tube into conduction, C1 becomes negatively charged; this blocks the grid because the discharge path is through the 10-megohm resistor. The peak-to-peak amplitude of the signal on the suppressor grid is about 20 volts.

A signal from the output of the sound IF detector is applied to the control grid of the tube. This also is a composite signal consisting of both video and sync pulses, but its

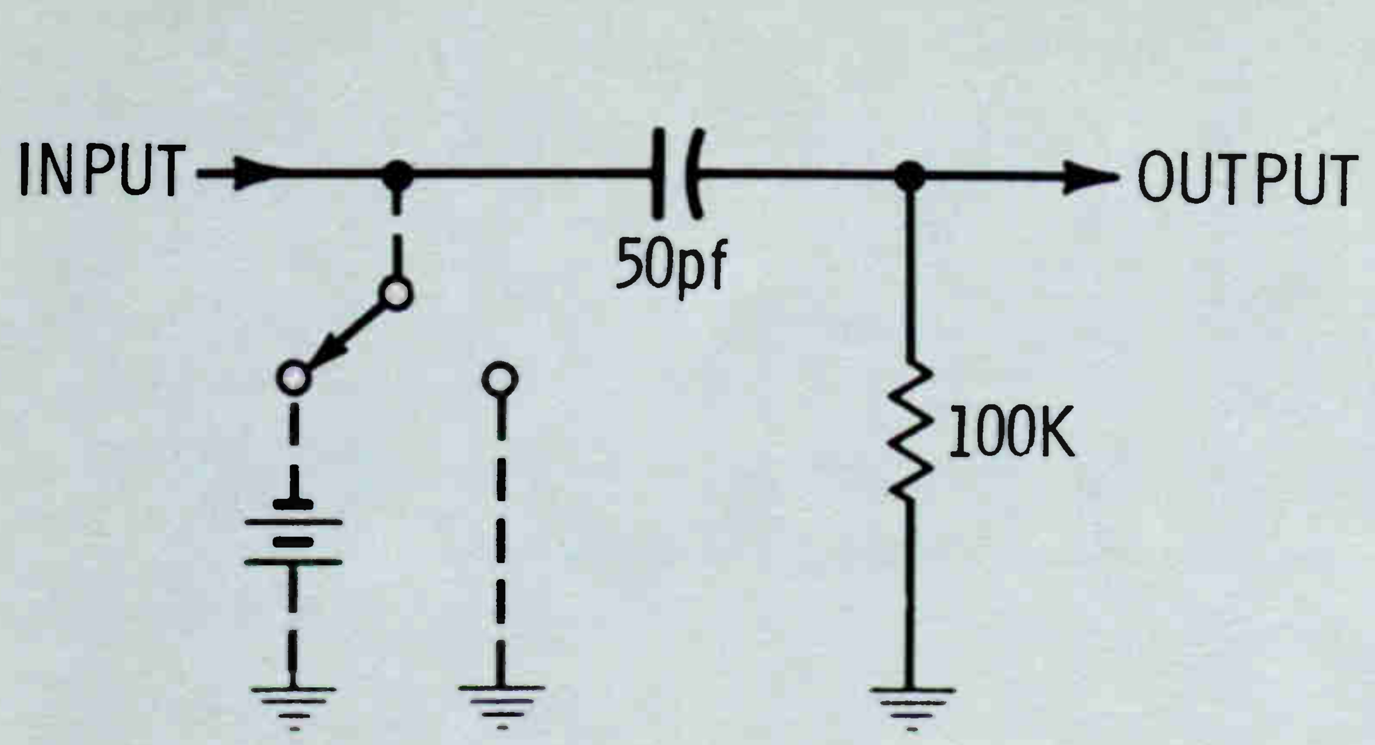


Fig. 3. Basic differentiator circuit.

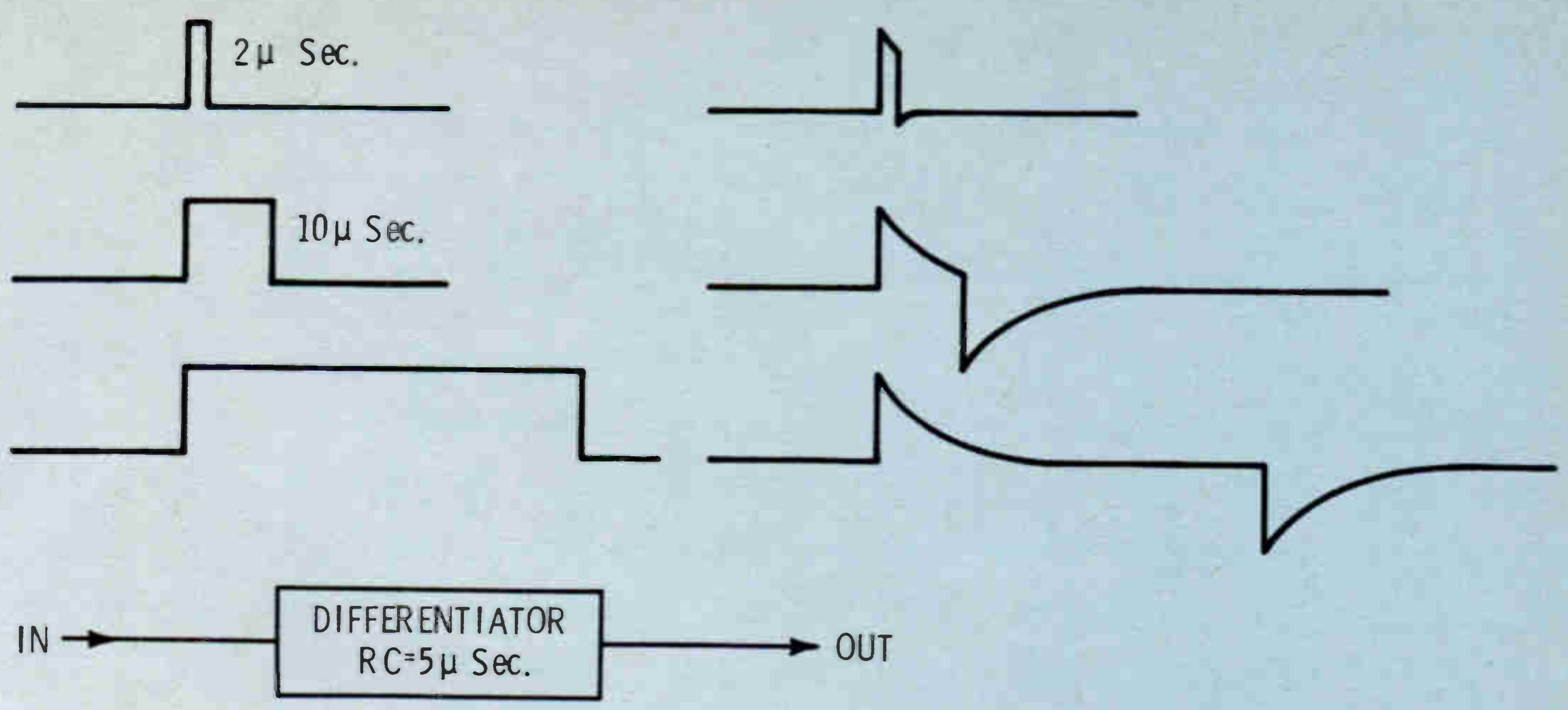


Fig. 4. Effect of a differentiator on square waves.

polarity is negative-going. The amplitude of this signal is only about 0.2 volt, peak-to-peak, but the gain of the tube is much greater for signals applied to the control grid; hence, the two inputs to the tube have a tendency to cancel each other. The various parameters are so chosen so that this input to the control grid does not cut the tube off under normal conditions, and so it can function as a sync separator.

If a noise pulse occurs, it will appear at both the control and suppressor grids of the tube. The circuit is so designed that if a noise pulse is sufficiently strong enough to otherwise upset the normal sync, it will be strong enough to also cause the control grid of the tube to cut off the plate current. Therefore, the tube cannot pass a noise pulse in the manner in which sync pulses are passed.

A number of other circuits which function in a similar manner have been used by various manufacturers. If sync separator circuitry is solid state, a somewhat different circuit is used. Fig. 2 shows a simplified version of the circuit used in the RCA CTC40 solid-state chassis. In this circuit, the fixed bias applied to the cathode of the diode holds it in cutoff during normal operation. If a noise pulse exceeds this fixed bias, diode X1 conducts and, in turn, causes the noise inverter transistor, Q2, to begin emitter-to-base conduction. The noise signal at the base of Q2 is inverted at the collector, which is connected directly to the input of the sync-separator inverter, Q3. As a result, noise pulses from Q1 and Q2 are effectively cancelled at the base of Q3, preventing noise spikes from being passed to the sync separator.

Separation of Horizontal Sync From Vertical Sync

In the article on vertical sync, it was explained that the horizontal sync pulses could be eliminated from the input to the vertical oscillator circuits simply by the use of an integrator or low-pass filter. To eliminate the vertical sync pulses from the horizontal oscillator circuits, it is necessary to use a variation of a high-pass filter, called a differentiator. A differentiator circuit is shown in Fig. 3. Notice that it appears to be nothing more than a simple RC coupling circuit.

It is possible to determine the effect of an RC coupling circuit on a square wave by determining the ratio between the duration of the square wave and the time constant of the circuit. The time constant is nothing more than the product of the resistance and capacitance, expressed in seconds. The RC time constant of the circuit in Fig. 3 is $5x10^{-11}x10^{5} = 5x10^{-6}$ seconds, or 5 microseconds.

It can be proven that if a DC voltage is applied to the input of the differentiator, at the first instant all of this voltage will be developed across the resistor and none will be dropped across the capacitor; this is really only another way of stating that current leads voltage in a capacitor. After a period of time equal to the time constant of the circuit, 5 microseconds in this instance, the capacitor will have become charged to about 65% of the applied voltage and the voltage across the resistor will have decayed to about 35% of the original value. After another interval equal to the time constant, the voltage across the resistor (which is the output voltage of the circuit) will have decayed to .35x.35, or $.35^2$ of the input. After an interval equal to 3 times the RC time constant, the output will be about $.35^3$ of the input, etc. It is customary to state that the output falls to zero after an interval of 5 times RC, or 5 time constants, although it may be shown that zero output never will be reached in a lossless circuit.

After the capacitor is completely charged, if the input is grounded, the output will rise immediately to the value of the original input voltage, but the polarity will be reversed. Then as the capacitor continues to discharge through the resistor, the output voltage will decay in the same fashion as it did before, reaching nearly zero after an interval equal to 5 times the time constant of the circuit. The effect of the circuit on three waveforms of various durations is shown in Fig. 4. Notice that the 2-microsecond pulse passes through the circuit with only slight distortion; the 10-microsecond pulse is distorted considerably, since its duration is equal to 2RC; and the 50-microsecond pulse is truly differentiated, the output falling to zero after 5RC, or 25 microseconds.

The differentiator between the sync separator and the horizontal-oscillator circuits normally has a time constant of about 5 microseconds. Accordingly, the horizontal sync pulses pass through it with only slight distortion. Of course, the equalizing pulses which preceed and follow the vertical sync pulse also pass with little change; but when the serrated vertical pulse appears, only the leading edge may pass, since it has a duration much greater than the time constant of the differentiator. The output from the differentiator with each of these three inputs is shown in Fig. 5. Notice that it remains approximately the

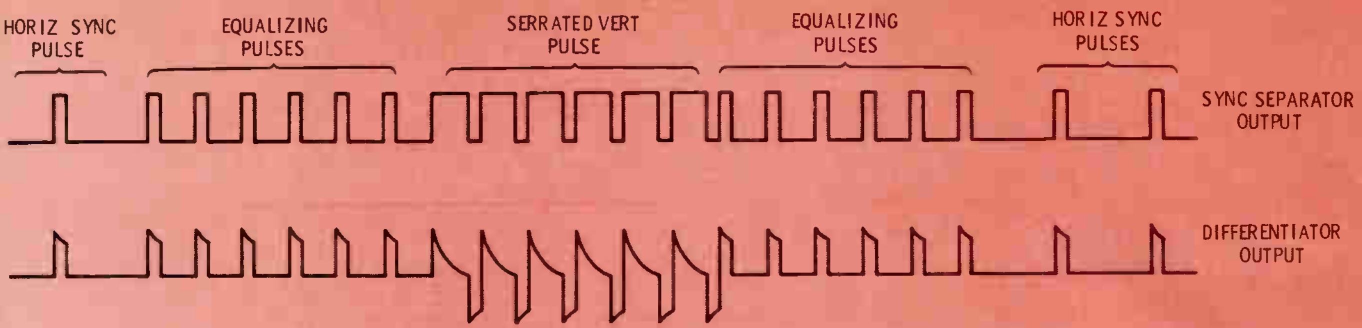


Fig. 5. Differentiated vertical sync pulse.

same in all cases, except that the number of pulses per unit of time is doubled during the vertical-sync interval. These additional pulses have no effect on horizontal frequency, since the oscillator cannot respond to sync pulses which do not occur at approximately the correct point in time.

The Horizontal AFC Detector

Over the years, many types of oscillators have been adapted for use as a horizontal oscillator. To be included in the list are blocking oscillators, multivibrators, Hartley, Colpitts and tuned-plate, tuned-grid types—these last three in both triode and electron-coupled pentode varieties. To attempt to compare the merits of each of these would be pointless, since it is really of little importance what type of oscillator is used, so long as it is stable and capable of having its frequency closely controlled by the sync pulses.

The usual method of determining if the frequency of the oscillator is correct is by means of a phase detector which measures the time relationship of the sync pulses and feedback pulses taken from the oscillator itself or from the horizontal-output transformer. The phase detector translates any timing error into a voltage which is proportional to the amount of error and whose polarity is determined by the direction of the error. If the oscillator frequency is too high, the feedback pulse will arrive at the phase detector before the sync pulse. In the circuit shown in Fig. 6, this produces a positive voltage which increases in amplitude as the amount of lead increases. Conversely, if the oscillator frequency is too low, the time interval between feedback pulses will be greater than the interval between sync pulses, and the output will swing negative. Again, the amount of voltage swing is determined by how much the feedback pulse and the sync pulse are out of synchronization.

Some receivers are designed so that the polarity of the output is reversed; i.e., too-high an oscillator frequency will produce a negative output and too-low a frequency will produce a positive output. In either case, it is customary for the phase detector to be designed so that its output is very close to zero when the oscillator is exactly on frequency. Determining the direction of the output of the phase detector is seldom necessary in servicing, but it can be an interesting exercise in circuit analysis. In general, it is simpler to analyze the AFC circuit which follows the phase detector to determine what input is required to raise the oscillator frequency.

From the aspect of servicing, it is important to remember that most phase-detector circuits are symmetrical. Notice in Fig. 6 that R111 and R112 have the same value; also the capacitance of C76 and C77, in series from the anode of X19 to ground, is equal to the capacitance of C75, which leads from the anode of X20 to ground. Although it is not apparent from the schematic, the two diodes also have the same characteristics, and in many receivers they are enclosed in a single package. If the circuit loses this symmetry, the output no longer will be zero when the oscillator frequency is correct. When this happens, the phase detector tends to "push" the oscillator out of sync, or off frequency. We all have seen how the picture shifts to the right so that the retrace-blanking bar is visible at the left side or near the center of the raster. This can be caused by failure of one of the diodes; remember that it also may be the result of one of the "paired" components drifting out of tolerance.

The fact that the normal output of the phase detector is zero makes it simple to determine if an off-frequency oscillator is the fault of the oscillator itself or the phase detector. Simply short the phase detector output to ground and observe the

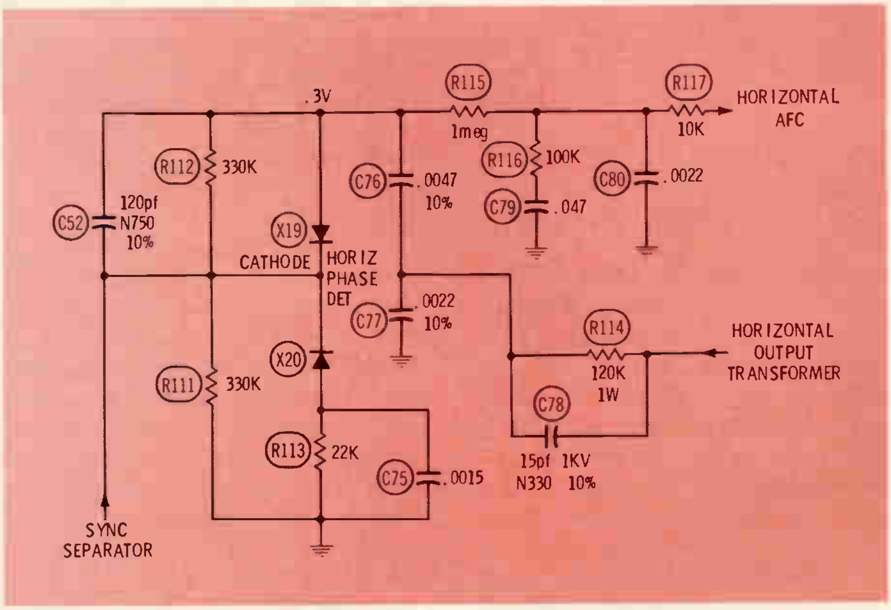


Fig. 6. Typical horizontal phase detector.

result. (The circuit impedance is high enough that the short will do no damage.) In Fig. 6, ground the junction of X19 and R115. The .3-volt potential indicated at this point was observed under no-signal conditions; the normal voltage is nearer zero. If the picture can be made to float across the raster with this point at ground, and if it tears, or attempts to sync with blanking bar visible, when the ground is removed, it is a reasonable assumption that the phase detector is at fault. (We have assumed that output of the sync separator was checked with a scope before this procedure was attempted.)

The output of the phase detector must pass through a low-pass filter before it can be used to control the oscillator frequency, because the output consists of a series of pulses having a repetition rate equal to the scanning rate (assuming there is an error signal). This must be integrated into a voltage which is essentially DC, changing in amplitude only when the oscillator tends to shift frequency. In Fig. 6, this filter is composed of R115, R116, and C79.

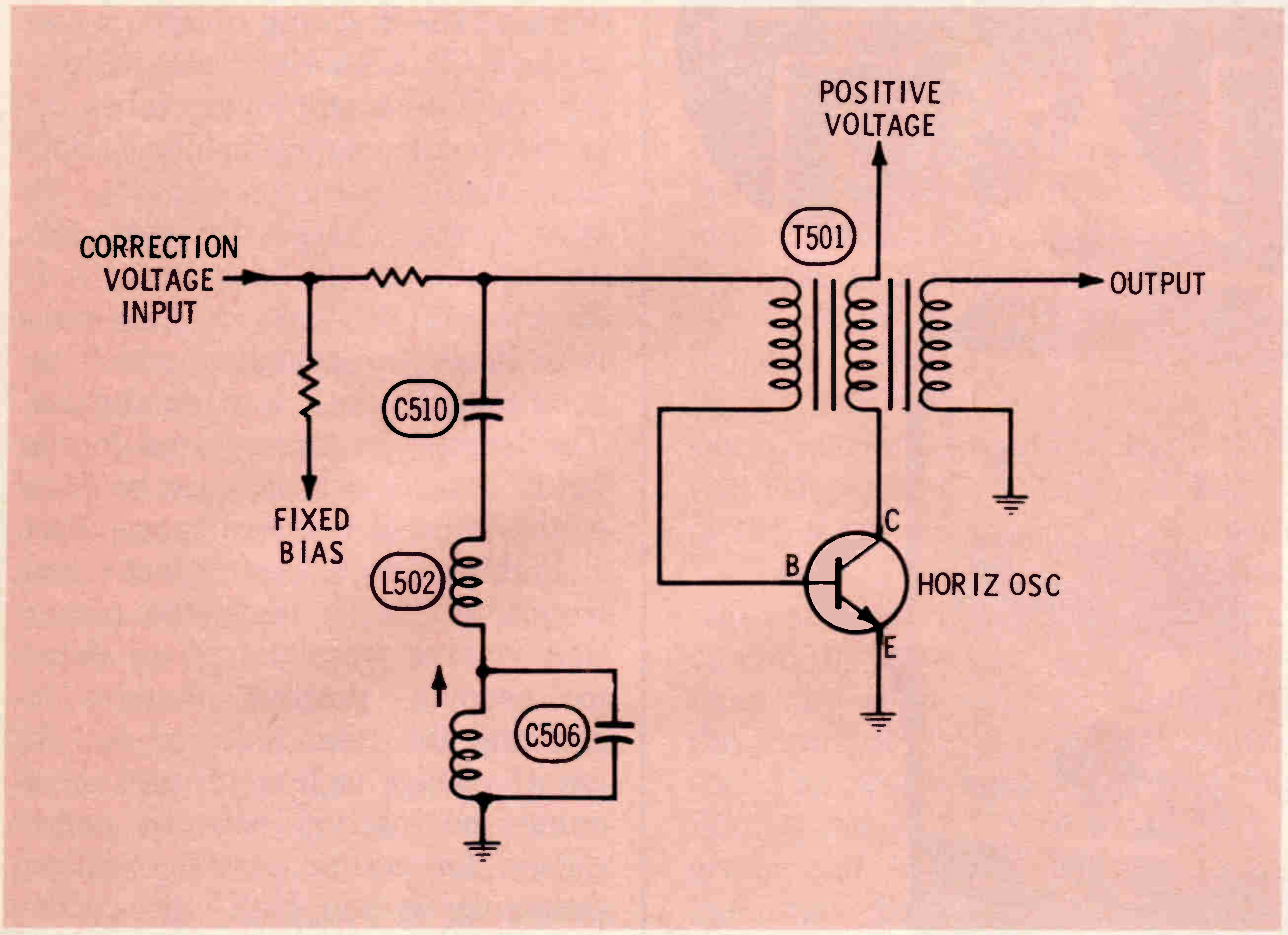


Fig. 7. A solid-state horizontal blocking oscillator.

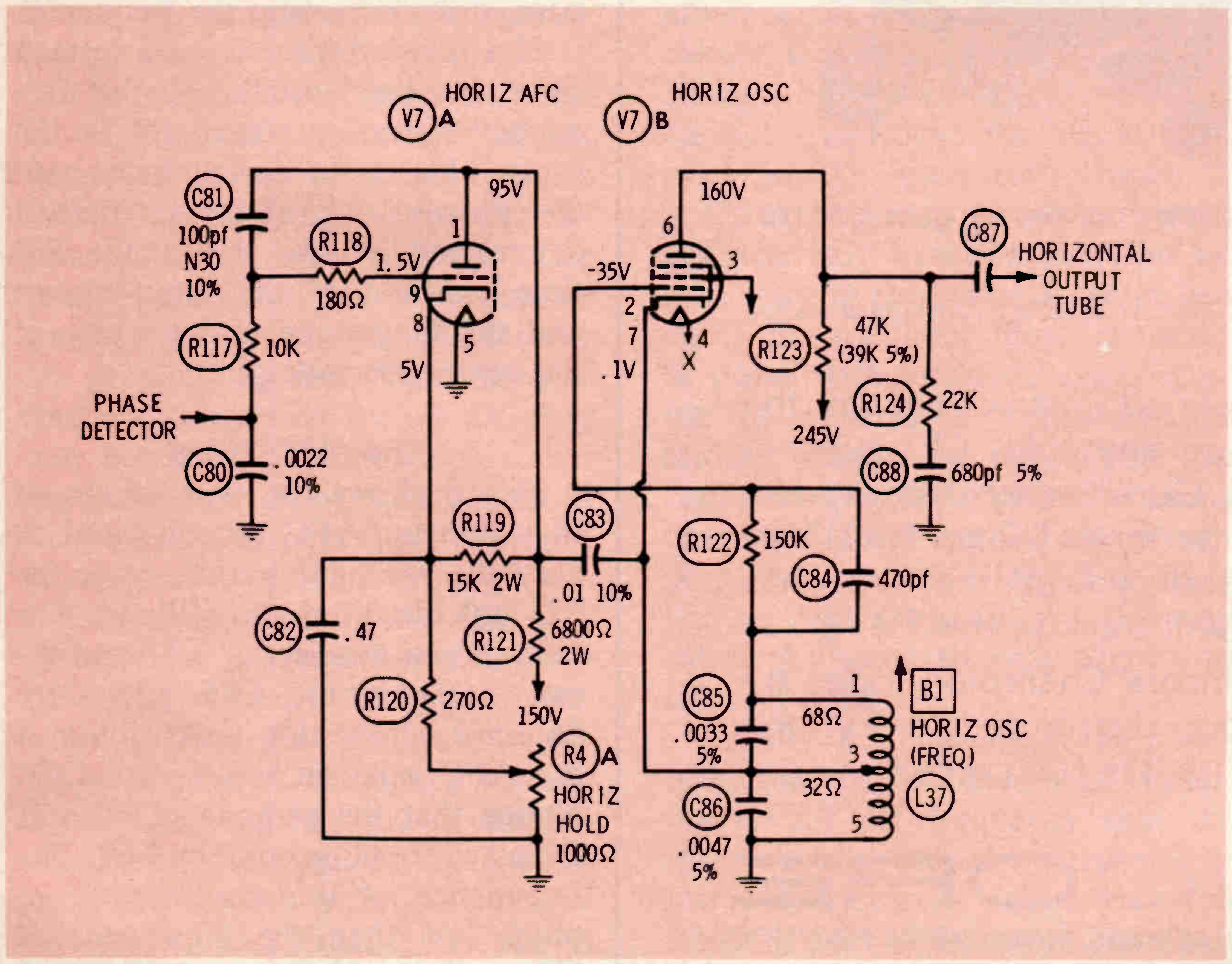


Fig. 8. Typical controlled reactance oscillator.

Of course, the amount of integration to be used is a matter of design, not of service; but since components change value on occasion, it is worthwhile to review just what the effects of too much or too little integration are. If there is too little integration (insufficient filtering), the error voltage applied to the oscillator, or AFC circuit, will tend to overcorrect the frequency. Thus, if the oscillator frequency is too high, the error voltage instantaneously will tend to drive it too low. This will be followed by overcorrection in the opposite direction, driving the frequency too high, etc. The result of this is that the interval for each successive scan line will be slightly different, causing the position of objects in the televised scene to jitter back and forth. Thus, a vertical line in the scene may appear to be broken or jagged.

Too much integration can cause an opposite condition: If the oscillator frequency is too low, the correction voltage will rise too slowly, allowing the low-frequency condition to continue for several scanning lines. This will cause that portion of the scene to be offset to the right by a slight amount. Then as the correction voltage arises to the necessary level, the portion of the scene being televised will drift back to its correct position; but by this time the output of the phase detector will have exceeded the necessary value, causing the scene to drift beyond its correct position. The result of this process is that vertical lines in the scene tend to drift back and forth slightly, causing a "wavy" picture.

Referring again to Fig. 6, too much integration could be the result of an increase in the value of R115 or C79. Conversely, a decrease in the value of either component would decrease the RC time constant and cause insufficient integration.

Direct Oscillator Frequency Control

The frequency of blocking oscillators and multivibrators can be controlled directly by applying the integrated output of the phase detector to the oscillator in a manner similar to that shown in Fig. 7. The circuit shown is a simplified schematic of the blocking oscillator used in the RCA CTC40 chassis. (Blocking oscillators employing tubes operate in the same fashion.) Each time the transistor conducts, the base current charges the capacitor, driving the device back into cutoff. As this voltage leaks off, the point is eventually reached at which the device again goes into conduction. The length of time required for the cutoff bias to leak off must be equal to the interval between sync pulses.

If this interval is too great (oscil-frequency is too high, the correction voltage from the phase detector becomes positive, thereby decreasing the time required for the cutoff voltage to leak off and shortening the interval between output pulses. Of course, if the oscillator frequency is too high, the correction voltage will become negative, increasing the time required for the blocking voltage to leak off of the base, thus decreasing the frequency.

If a multivibrator is used instead of a blocking oscillator, the frequency-control process still is the same. That is, the device under control remains cut off for an interval determined by two things: the RC time constant of the input circuit and the magnitude and polarity of the correction voltage.

The AFC Tube

Fig. 8 shows the type of circuit in which an AFC tube is used to vary the resonant frequency of the LC tank circuit of an oscillator. The tank circuit consists of L37 and the two capacitors, C85 and C86. Shunted across this tank circuit is the AFC tube, in series with C83. Notice that the cathode of V7A is bypassed to AC ground by C82. The impedance of this capacitor is so much less than the impedance of C83 and the AFC tube itself that it has little effect on the total impedance.

V7A has two inputs: the integrated output from the phase detector shown in Fig. 5 and, also, the horizontal-oscillator signal from the cathode of V7B. This signal is shifted in phase by C81, R117, and C80 so that the voltage at the grid of the AFC tube leads the voltage at the plate by nearly 90°. This leading voltage at the grid causes a leading current to appear at the plate, and this current flows through the tank circuit of the oscillator.

Since a leading current in a circuit is the same as a capacitance current, the AFC tube may be considered as an additional capacitor connected across L37. The correction voltage from the phase detector changes the conduction of V7A; therefore, this tube is essentially a variable capacitor connected across L37, and its capacitance at any moment is determined by the amount and polarity of correction voltage fed to its grid.

In troubleshooting off-frequency horizontal oscillators, the first step is to determine that the phase detector, or its integrator, is not causing the problem. The phase detector may be eliminated by grounding its output to the integrator. If the oscillator returns to the correct frequency under these conditions, it is safe to assume that it is operating properly.

The integrator can suffer a change in time constant (with the results described above), or it may open or short. Depending on the specific circuit, this may cause the oscillator to stop, shift well off frequency, or simply drop out of sync. Since there are probably no more than three or four components in the circuit, they may be checked rather quickly with an ohmmeter, or by substitution in the case of a suspected off-tolerance capacitor.

Obviously, the output of the AFC tube can neither be disconnected nor grounded without changing frequency, since the AFC tube is actually a part of the tuned circuit. This leads us to a point of emphasis: Frequency troubles are just as apt to be caused by the AFC circuit as by the oscillator. There is no easy way to isolate troubles caused in one circuit from troubles caused in the other. It is worth noting that temperature-sensitive components in either circuit are a constant cause of problems. The ones most likely to cause trouble are those actually in the signal paths, rather than bypasses such as C82 of Fig. 8.

Summary

Some problems with horizontal sync may be diagnosed fairly accurately by observing the raster. For example, loss of both horizontal and vertical sync indicates trouble in the sync separator itself or in the receiving section. Techniques for locating these faults were covered in the previous article on vertical sync. Remember, however, that faults in these areas may affect horizontal sync, but not vertical sync, and vice versa depending on which oscillator is the more tolerant of poor sync.

Complete loss of horizontal sync with normal vertical sync can be caused by any part of the circuit from the sync-separator output to the input of the horizontal oscillator. The scope is the best tool for finding the fault, although the integrator and AFC tube and components may be checked roughly by grounding the integrator input and alternately injecting a small voltage (about .5 to 1 volt, positive and negative) at this point. If this procedure causes the oscillator frequency to change, but yet remain close to the correct frequency, the signal path prior to the integrator is open.

Other failures produce rather characteristic symptoms: Loss of symmetry in the phase detector can cause the oscillator phase to swing of phase with incoming sync, causing the scene to be "split down the middle." Improper integration can cause the oscillator phase to swing back and forth across the proper point, resulting in a jagged or wavy picture. Partial loss of sync also may cause the scene to drift slightly to left and right.

Finally, don't overlook the possibility that the oscillator itself is pulling so far off frequency that the sync circuits cannot correct it. In this event, suspect any capacitor which is part of the tuned circuits. ▲

Single-and Double-Ended Audio in Auto Radio

Analysis of audio circuits in today's auto radio chassis.

by Wayne Lemons

Many circuit changes have been made in auto radio since the first transistor radios were introduced several years ago. At first glance, it seems that the circuits have been getting more complicated as we advance in the transistor age. The early output stages consisted of a single driver transistor transformer-coupled to a single class A power transistor. Both transistors were of germanium type. Today about the only germanium transistors still in use are in the power output stages, and these are rapidly being eliminated in favor of the smaller, less-heat-sensitive silicons.

The Delco 1969 circuits (Fig. 1) continue to use the germanium single-ended output with direct-coupled drivers, as they have been doing now for two or three years. From the collector of the power transistor (Q3), DC bias stabilization is applied through R3 and R1 to the base of Q1. If the current of Q3 increases for any reason, the voltage fed back to the base of Q1 becomes more positive, lowering the collector voltage of Q1 and the bias on Q2. With the bias of Q2 lowered, there is less current flow through R11, and less bias voltage is supplied to the base of Q3 which, in turn, lowers the current of Q3 and re-establishes equilibrium.

This circuit also uses a second feedback stabilization loop around the first two stages: The emitter voltage of Q2 is fed back through R4 to the base of Q1.

A bleeder circuit (R7-R10) establishes the operating point for the emitter of Q2. Inverse audio feedback is fed to the bottom of the volume control across R9 to improve frequency response and to decrease distortion of the circuit. R5 in the emitter of Q1 is used to adjust the output current of Q3, in addition to establishing bias levels for all stages. A 0.47-ohm fusible resistor in the emitter circuit of Q3 will open if current through it exceeds about 2 amperes.

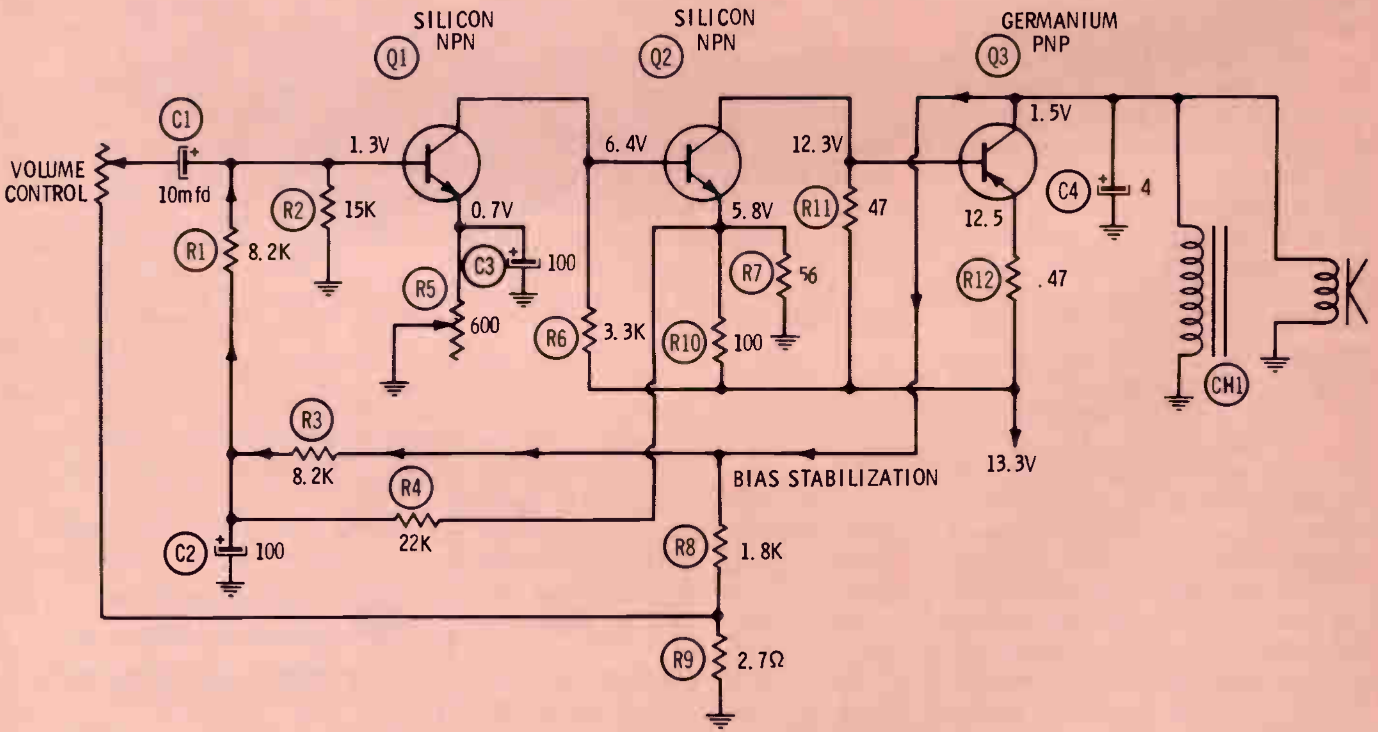


Fig. 1 Delco auto radio audio circuits continue to use germanium single-ended output with direct-coupled drivers. Arrows indicate bias stabilization feedback path.

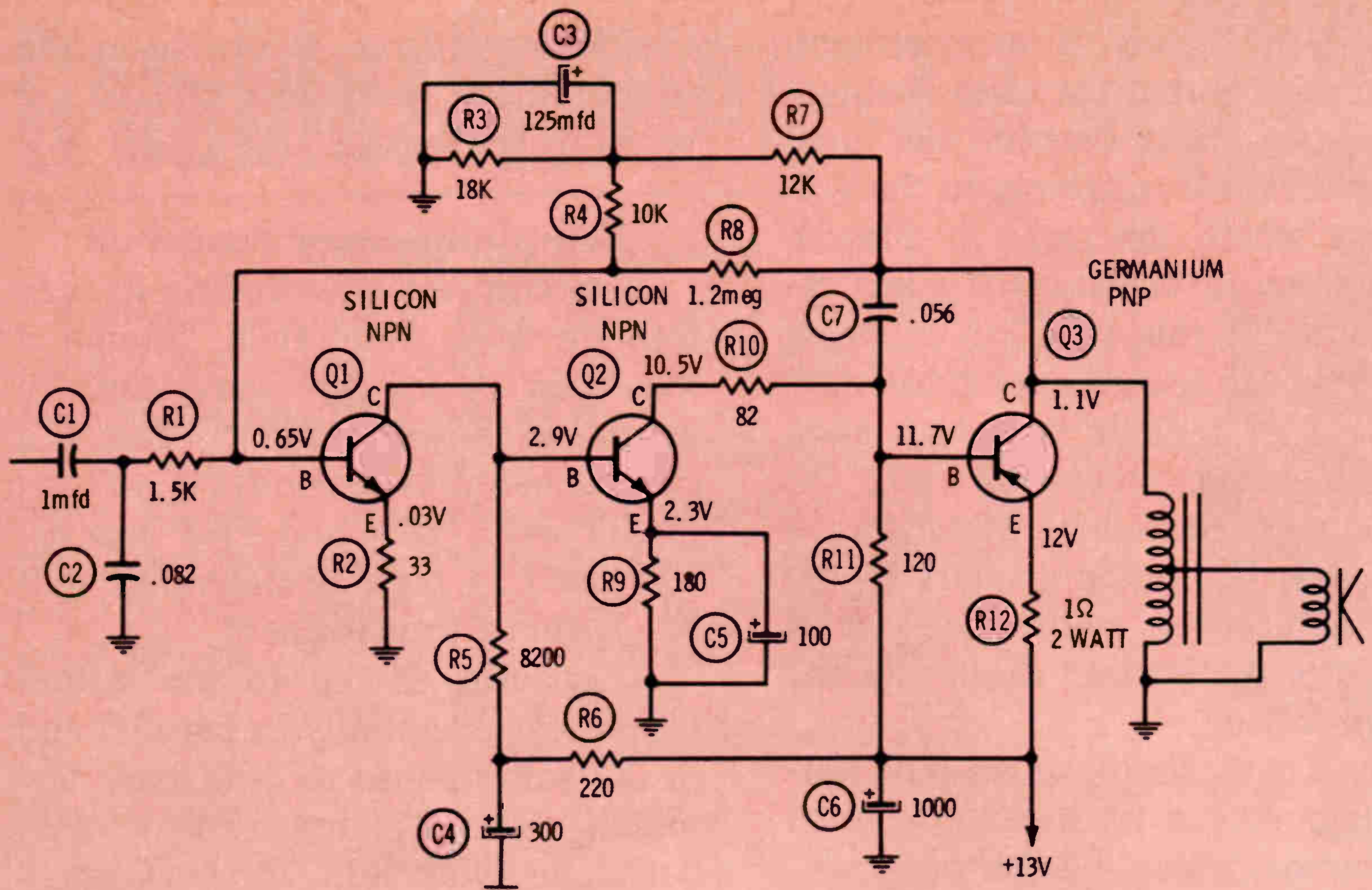


Fig. 2 Phillips Dodge truck radio employs two stabilization feedback paths between the collector of Q3 and the base of Q1.

Other Direct-Coupled Circuits

The circuitry in Fig. 2 is somewhat similar to that in Fig. 1, but without a bias adjustment and with a somewhat different bias circuit. There are two feedback paths between the collector of Q3 and the base of Q1. One is a simple audio negative-feedback circuit through R8. The other is a DC bias stabilization path through R7 and R4. C3, between these two resistors, filters the audio out of this circuit. As in the circuitry of Fig. 1, the feedback paths improve linearity and eliminate the possibility of a thermal runaway by regulating the current of the output stage so that it stays within safe limits.

Fig. 3 is still another direct-coupled circuit, but this one uses a silicon NPN output transistor. The circuit is similar to the other two except for the stabilization path and the use of one NPN and one PNP silicon driver transistor. The stabilization is from the emitter of Q3 to the emitter of Q1. Here's how it works: If for any reason the current increases through Q3, the emitter voltage of Q3 rises thus increasing the voltage fed back to Q1. This, in turn, increases the collector voltage of Q1, decreasing the bias on Q2 (PNP) and reducing the bias voltage of Q3 (drop across R10)—the circuit balances itself. C5 filters the audio from the bias stabilization line to prevent inverse feedback, which would drastically reduce the gain of the three stages.

An audio feedback circuit from the collector of Q2 to the emitter of Q1 (via C3-C2) reduces the high frequencies and helps prevent transients from reaching Q3. A second negative feedback circuit feeds the voice coil voltage to the emitter of

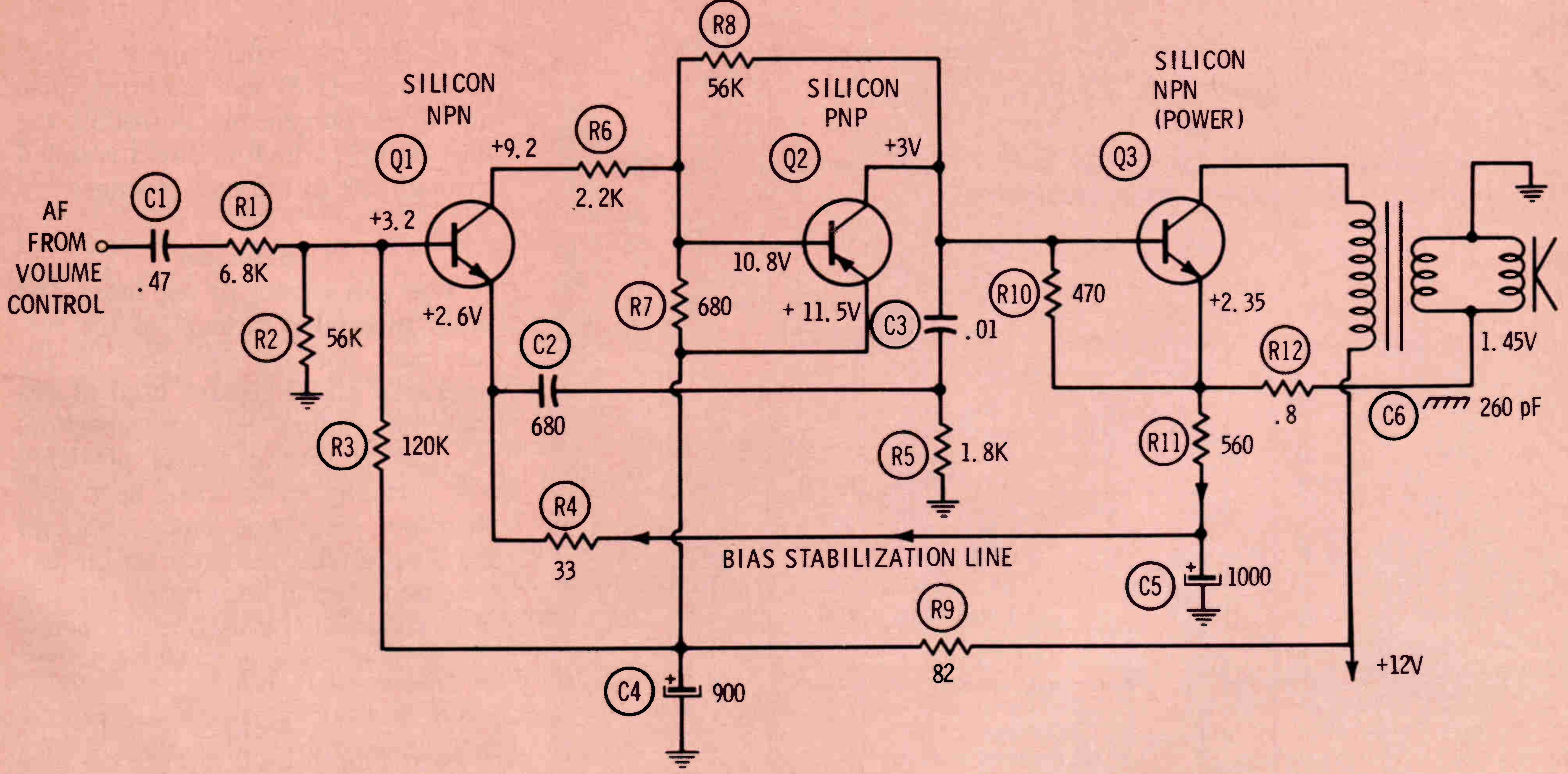


Fig. 3 Bendix auto radio employs a single-ended, direct-coupled audio circuit with an NPN silicon output transistor.

Q3 through R12. R12 is also the protective resistor for the circuit.

Push-Pull Audio

So far we've been discussing single-ended class A circuits. These circuits, by their nature, must draw from 600 to 1500 ma to supply sufficient undistorted power output. The total radio current is about 15 to 30 ma more than the output circuit uses. This total current is much less than the drain of the old tube radios (about 3 to 6 amperes), but is still enough to produce quite a lot of heat, and, if played for a considerable length of time without the engine running, can exhaust a battery.

With more and more stereo, both from FM multiplex and from tape sources, it now appears that most manufacturers will go to some sort of push-pull class B arrangement. The reason is that the class B stages draw little idling current and total battery drain is relatively to the volume at which the radio is played. Though more transistors are required, even this problem is being solved by the use of dual transistors mounted in a single transistor case, and integrated circuits to make the problem of additional transistors a minor one. By going to class B, the manufacturer can reduce the size of the radio, the battery drain and the heat produced.

Fig. 4 is a simple push-pull output stage driven by a center-tapped audio transformer. The output transformer is also center-tapped, with the speaker connected across a portion of the winding. R7 and R8, two 0.2-ohm resistors, are for circuit protection. The positive temperature coefficient resistor, R4, reduces the output bias if transistors Q2 and Q3 begin to heat up.

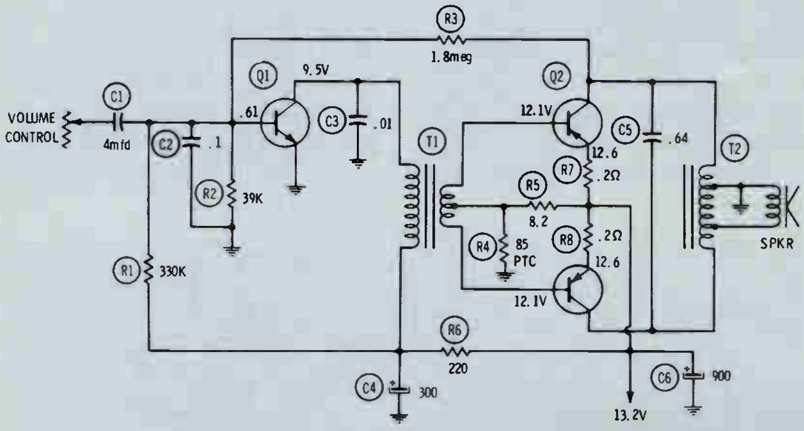


Fig. 4 Dodge truck radio Model 707 uses a simple push-pull output stage driven by a center-tapped audio transformer.

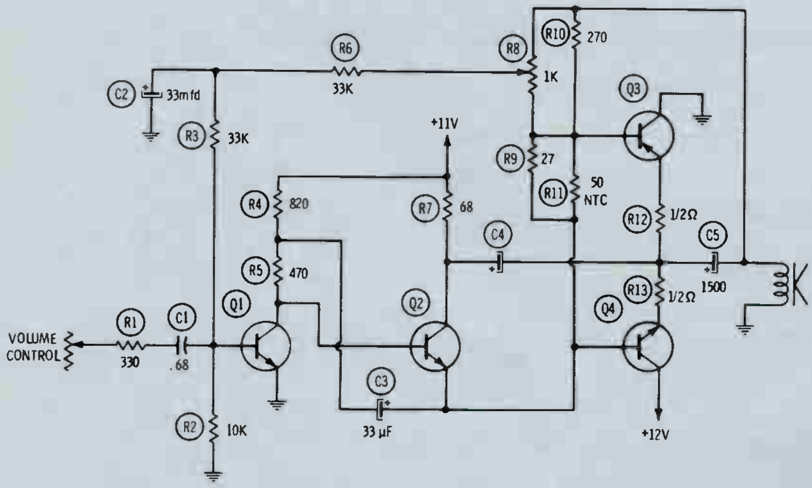


Fig. 5 Complementary-symmetry output circuit, shown here with NPN and PNP transistors, provides push-pull output without using transformers.

Complementary Push-Pull

A circuit just now finding its way into the auto radio field, though it has been in use for some time in others, is shown in Fig. 5. This is a complementary-symmetry output circuit with NPN and PNP transistors used to provide push-pull output without transformers.

The audio is fed to the output transistors essentially in parallel and in the same phase to both base terminals. The 27-ohm resistor, R9, parallelled with R11, the NTC (negative temperature coefficient) resistor, provides bias stabilization and the tiny difference in bias required because of the two ½-ohm emitter resistors. In some circuits the NTC resistors (R11) is replaced with a diode. Since Q3 is a PNP transistor, a negative half cycle of input signal turns it on, charging capacitor C5 through the speaker and through the emitter-collector circuit of Q3. On the positive half cycle the NPN transistor Q4 conducts, discharging C5 through the speaker and the emitter-collector circuit of Q4.

The complementary connection eliminates phase reversal transformers or phase inverters and allows direct coupling.

In this particular circuit a bias adjustment (R8) sets the initial bias and idling current by controlling the bias on Q1, which is direct coupled through Q2 to the output stages.

Conclusion

You can expect to see more and more integrated circuits in the future and perhaps even completely packaged audio circuits used in automobile radios. Silicon transistors in class B output stages probably will virtually eliminate heat and, therefore, the heat sink. Although the field-effect transistor so far has not been used in auto radio, it probably soon will be used either separately or in packaged circuits.

Next

Next month we'll discuss the best ways to service direct-coupled circuits, how to set bias adjustments, precautions to take, the best way to tell if a transistor is bad without removing it from the circuit and other important and helpful tips. ▲

troubleshooter

Which Scope Probe?

I would like some help with an Eico Model 460 scope I purchased about a year ago. I haven't figured how to get anything out of it.

The scope has a direct/demodulator/low-capacitance probe. It also has inputs marked, vert., hor., ext. sync, sawtooth, ext. cap., Z-axis and 60 cycle. I want to know which probe goes in which input to do what job on color, b-w and transistor television.

Jerry Purdy
Lake Hamilton, Florida

This is too complete a subject to be covered completely in this column, but there is an article on the subject in this issue of ELECTRONIC SERVICING.

There are really no special probes to be used on color TV versus b-w, or tube circuits versus transistors. Instead there are probes for specialized measurements, regardless of what equipment is being tested.

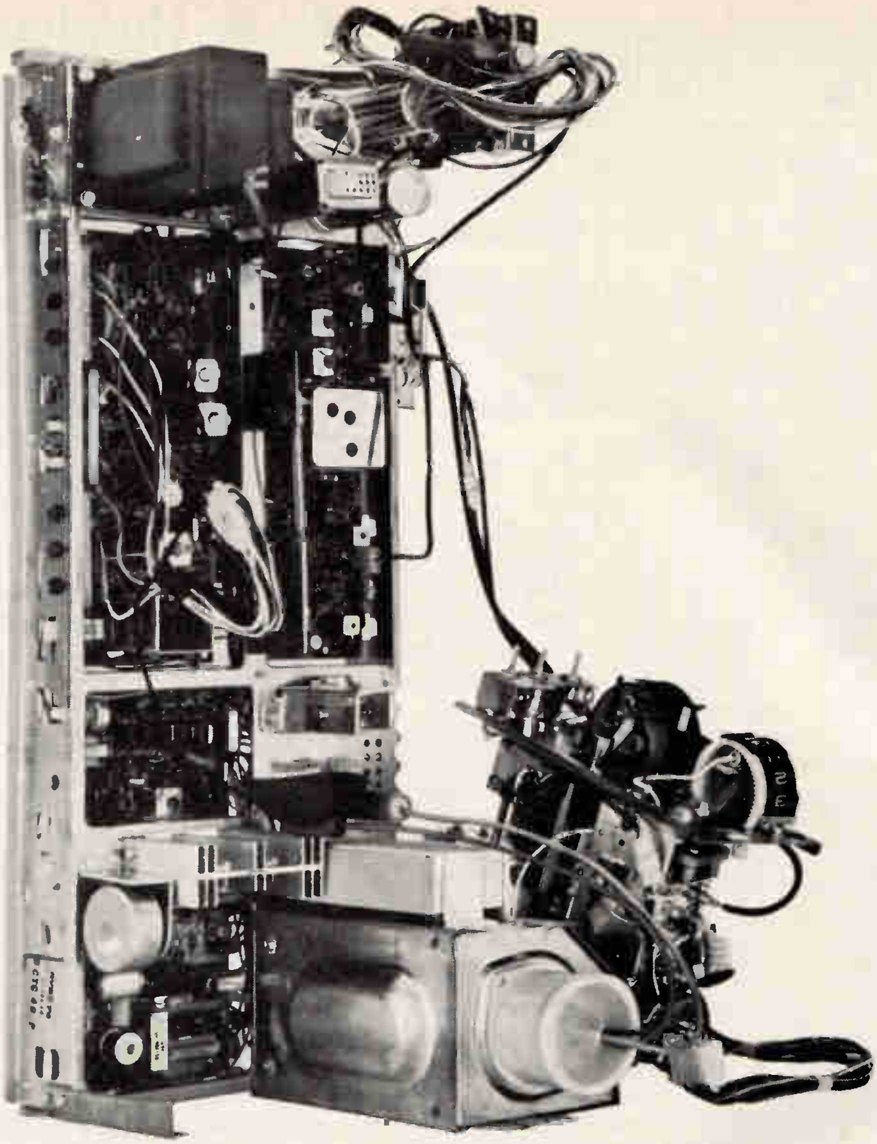
A direct scope probe is usually connected to the scope with shielded cable (to avoid hum pickup) and the cable adds capacitance to the circuit under test; a typical probe will have 90 to 100 pf of capacitance. This capacitance means little in an audio circuit, but it will completely wipe out the tuning of an IF stage. The exact amount of signal change depends on the impedance of the circuit and the frequencies involved. In video circuits, a direct probe will smear the picture, and it may kill a color oscillator or burst circuit. A low-capacitance probe reduces this loading capacitance to around 10 or 12 pf (which is still enough to cause trouble in some circuits) and gives a 10 to 1 loss of signal to the scope. Here is a good tip: Use the low-capacitance probe for *all* waveforms, except where the measured signal is too low to be seen, in which case you should use the direct probe for added gain.

A demodulator probe is merely a detector, and is intended to be used in any RF or IF stage where there is enough signal to be seen. It is to be used wherever the frequency is above the top frequency response of the scope.

Video and chroma signals are less than 4.5 MHz in frequency and the low-capacitance probe should be used to measure such signals. Vertical or horizontal circuits are also best checked with the low-capacitance probe.

No matter which probe is used, it should be attached to the scope's "vertical" input to provide the height of the waveform; the horizontal part of the trace is usually supplied from the built-in horizontal sawtooth generator. You seldom will use the external horizontal, Z-axis or 60-cycle functions.

Waveforms that are hard to lock at 7875 Hertz (to give two horizontal frequency waveforms on the screen), such as video or chroma signals, are much easier if the sync selector switch is set for "ext. sync" and a clip lead attached to the "ext. sync" connector. Then just position the wire close to the horizontal sweep circuit where it will pick up some of the hori-



There's more here than meets the eye.

What you are looking at is RCA's solid-state* color chassis—the CTC-40. A whole lot went into that chassis. Like fifteen years of technical research. Pioneering in the development of Solid State. And the backing of a national workshop program like nobody else's.

That's where you come in.

We've written a technical manual on the CTC-40 especially for Electronic Service Technicians. It has color diagrams, pictures, and everything there is to know about our CTC-40.

You can buy it from your RCA Consumer Electronics Distributor, but there's a better way.

Attend the next RCA Consumer Electronics Distributor CTC-40 Workshop and get the manual free. Our distributor can tell you when it will be held next in your area. See you there.

*one tube rectifier

RCA

zontal pulse; the scope will usually lock in very tightly.

Most of the scope patterns in the PHOTOFACT folders were taken with a low-capacitance probe on a good scope.

We hope this information will help you get started using your scope regularly, for a scope is one of the most important items of test equipment for servicing television.

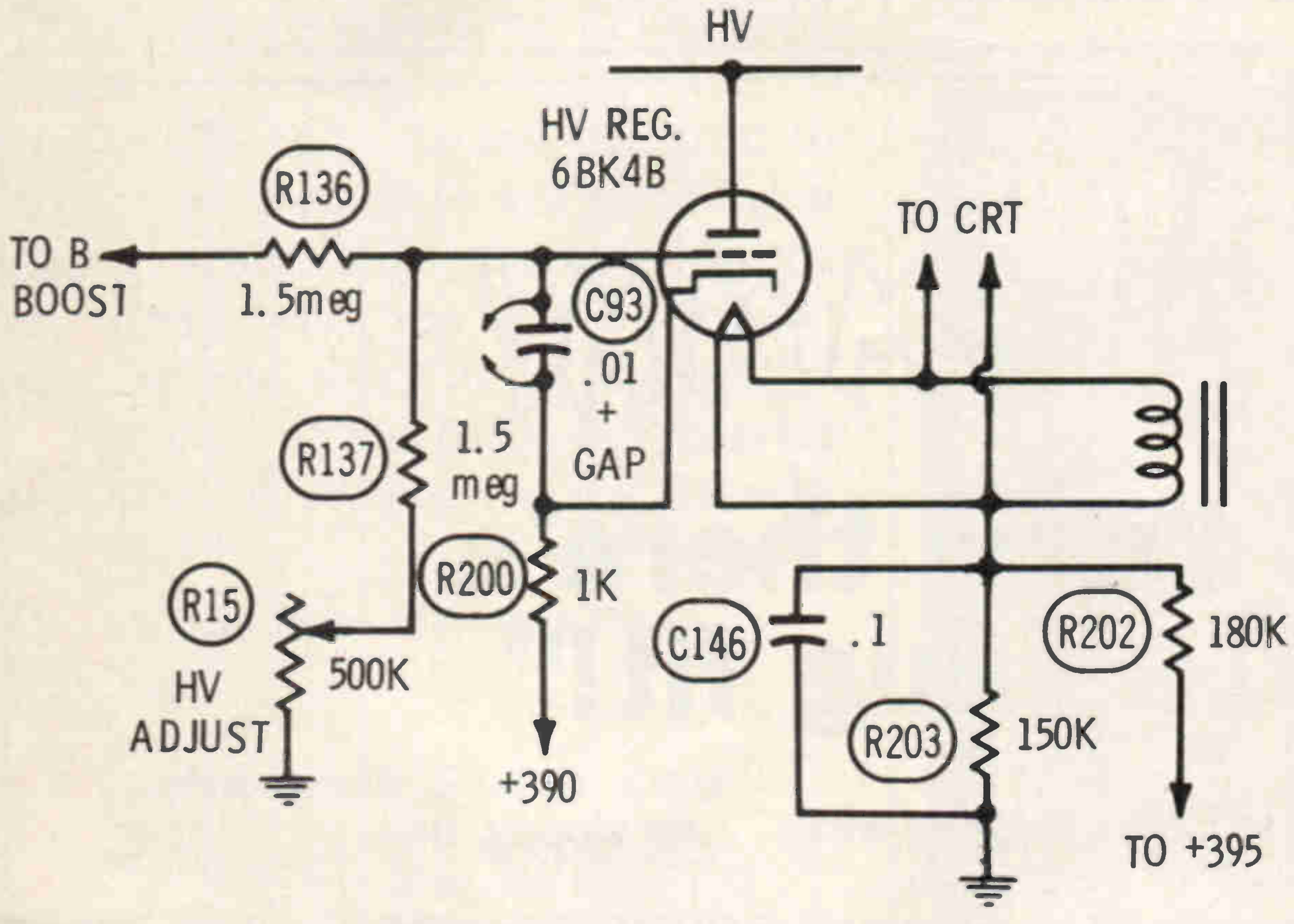
No Raster, Good Sound

I have been a subscriber to PF REPORTER for over 10 years and wish to thank you for the very fine technical articles.

I am having trouble with a Zenith portable TV, chassis 14M20Z (PHOTOFACT folder 741-4). The raster disappears in about a minute and only the sound remains. All horizontal tubes, flyback transformer and many other parts have been replaced . . . I will certainly appreciate any suggestions.

J. G. Sanchez
Hanford, Calif.

At the bottom of your letter, you stated that the high voltage measured 15 KV and the boost voltage was normal. If these voltage levels are present after you lose the raster, the answer to the problem will be found in the picture tube cathode or grid voltages. Leakage in C21, the .1-mfd capacitor connected from the contrast control to the cathode of the CRT, would make the cathode too positive and bias the picture tube to cut-off. An open or an increase in the value of R39, the 100K resistor connected from the bright-



ness control to the cathode of the CRT, also would make the cathode too positive.

Loss of the +50 volts on pin 7 of the CRT (grid) might also darken the picture. An open in the socket or wiring between pin 7 and ground also would give the same symptoms. ▲

Change of Address?

To receive Electronic Servicing at your new address, send an address label from a recent issue and your new address to:

Electronic, Servicing, Circulation Dept.
1014 Wyandotte St., Kansas City, Mo. 64105

Circle 31 on literature card →

book review

1-2-3-4 Servicing Automobile Stereo: Forest H. Belt & Associates, Howard W. Sams & Co., Inc., Indianapolis, Indiana 46206; catalog number 20737, 192 pages, 5⅜" x 8½", paperbound, $3.95.

Forest H. Belt, an author whose articles and books are familiar to many service technicians, has combined in one efficient system of servicing the basic techniques that successful technicians have been using for years. Called "1-2-3-4 Servicing", the system involves the disecting of any electronic instrument into first sections, then stages and circuits and, finally, parts. While such a disecting technique has long been the basis of most logical troubleshooting systems, Belt has expanded and clarified the specific procedure—diagnose, locate, isolate or pinpoint—that should be employed at each of these levels. A detailed explanation of how this logical and effective system of servicing applies to electronic equipment is given in Chapter 1, while the system is applied to mechanical equipment (record changers) in Chapter 2.

"Automobile Stereo as a System" is the title of Chapter 3, which provides a general description of FM multiplex receivers and stereo cartridge tape players, including block diagram analysis of current, representative designs.

Chapter 4 reviews the basic theory and operation of sections, stages, circuits and parts employed in a stereo-FM multiplex receiver.

A detailed analysis of the electronic and mechanical operations of cartridge-tape units is presented in Chapters 5 and 6.

An introduction to the application of the 1-2-3-4 system of troubleshooting to auto stereo is given in Chapter 7 to prepare the reader for the more detailed, step-by-step, procedural instructions outlined in Chapters 8 through 11.

The logical manner in which the subject matter of this book is presented makes it suitable for students and beginning technicians as well as experienced servicers of electronic equipment. ▲

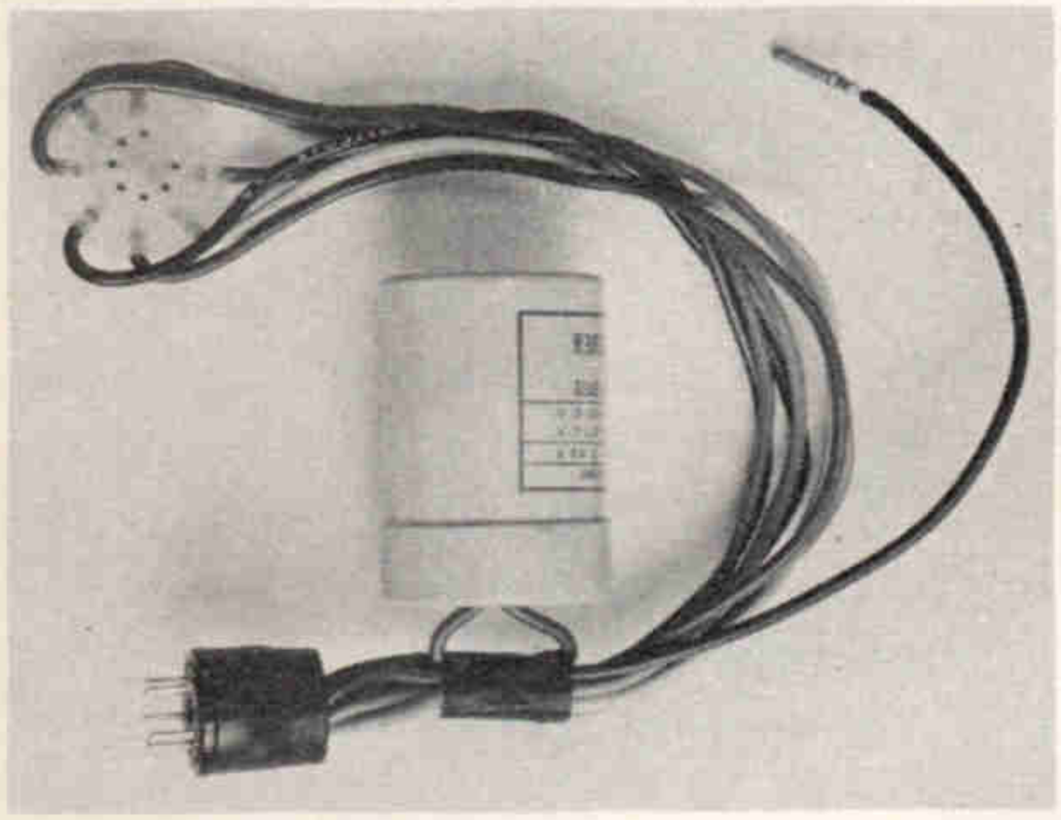
product report

for further information on any of the following items, circle the associated number on the reader service card.

Mini-base CRT Servicing Kit

The Telematic Division of the UXL Corp. has introduced the MSK-698 service aid kit, designed specifically for servicing mini-based CRT's.

Included in the kit is the CR-12, called a Mini-base brightener. According to the manufacturer, it operates on 6.3 and 4.5 volts AC (parallel). The unit has a flexible socket which permits mounting in cramped places.



The CR-165 adapter, designed to permit servicemen to test mini-based picture tubes, also is included in the kit along with the CR-84 socket adapter and the CR-88 extension.

The cost of the MSK-698 service aid kit is $6.98, and the CR-12 sells for $2.75.

Circle 60 on literature card

Solid-State Solder Gun

A solid-state, transformerless soldering gun, featuring a high/low temperature selector switch, has been introduced by Ungar. The unit weighs only five ounces, due to solid-state design which requires no transformer.

The gun is designed primarily for use by radio-television service technicians, electronic research-and-development lab technicians and electronics hobbyists. According to the manufacturer, it is uniquely designed to assure damage-free soldering of integrated circuits and field-effect transistors by electrically isolating the soldering tip from the heating element with a grounded three-wire cord set to render the tip

electrically inert.

The user has a choice of two ranges of tip temperature. To select a tip temperature of approximately 500° or 900°F., the technician simply slides a thumb-switch on the gun handle to **"lo"** or **"hi"**.

Soldering tips are independent of the heating element for replacement purposes. The heat cartridge locks into the gun barrel by means of a knurled nut. Loosening the nut allows rotation of the entire cartridge to orient the thread-on tips.

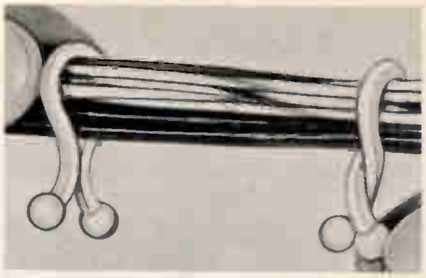
Included in the purchase price of the #6760 solder gun are three interchangeable tips: Short Chisel, Pyramid and Long Chisel types. The design of the Ungar gun is such that all basic parts are replaceable separately. The gun, complete with cord set, interchangeable tips and all replacement parts, is priced at $13.25.

Circle 61 on literature card

Easy-to-Apply Wire Tie

The Richlok Corporation has introduced the Twist-Lok Wire tie. According to the manufacturer, it can be fastened around a wire bundle in less time than it takes to explain it. The horseshoe-shaped plastic tie is placed over a wire bundle, given a twist and the tie is firmly locked. It is opened in the same manner and is re-usable.

Twist-Lok Wire Ties are available in four colors for coding and in two sizes to accommodate wire



bundles from .200" to .500" in diameter.

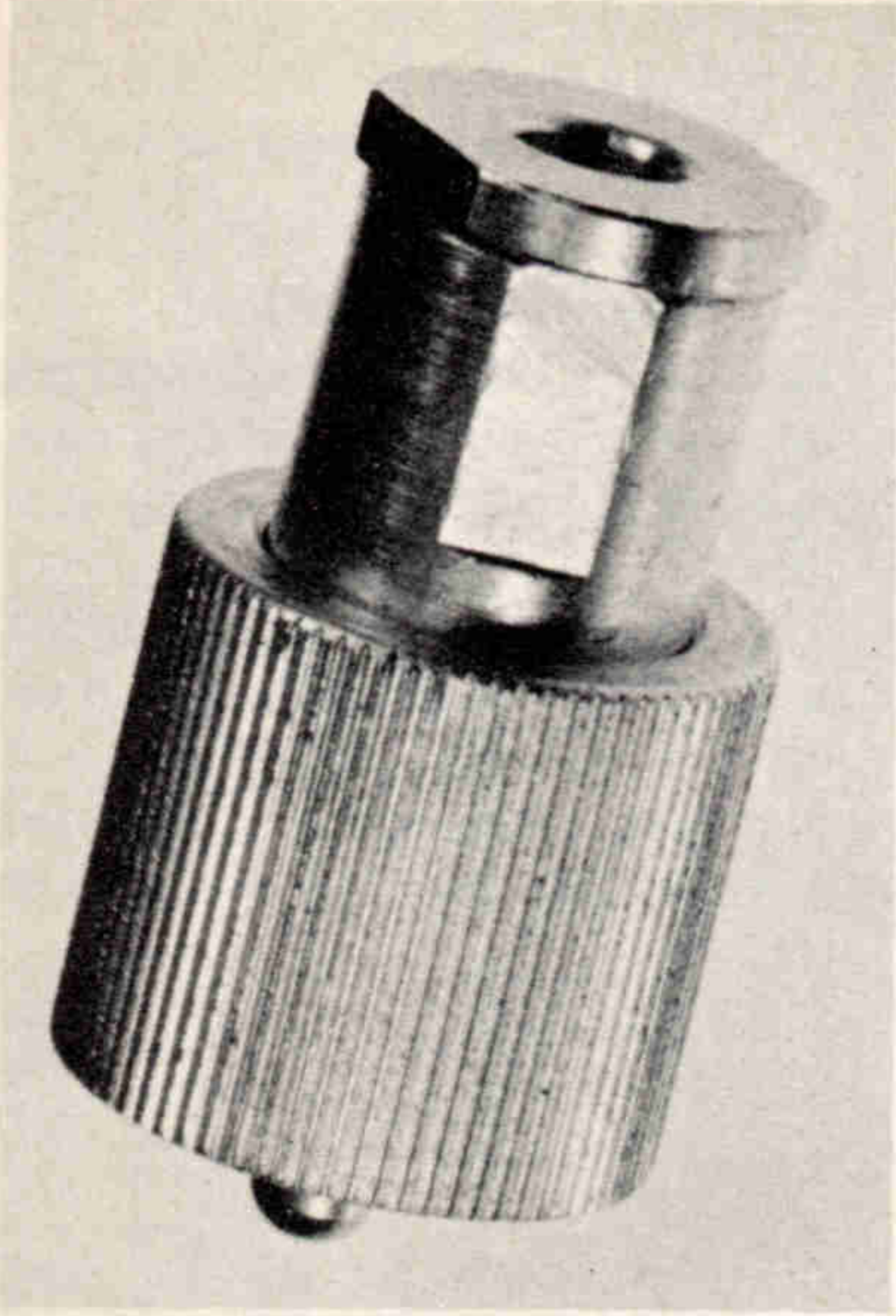
The prices range from $35.53 per 1000 for purchases less than 2,500 to $6.93 per thousand for purchases of 50,000 and over, depending on the type of ties purchased.

Circle 62 on literature card

Solderless Connector

A solderless connector, PL 259, has been developed by Gold Line Connector, Inc. Standard in all respects with the regular PL259, this connector is easily and quickly assembled with ordinary tools, according to the manufacturer.

Presently available are the Gold Line connector GLC 89 for 58/U



cable and the Gold Line connector GLC 90 for 59/U cable.

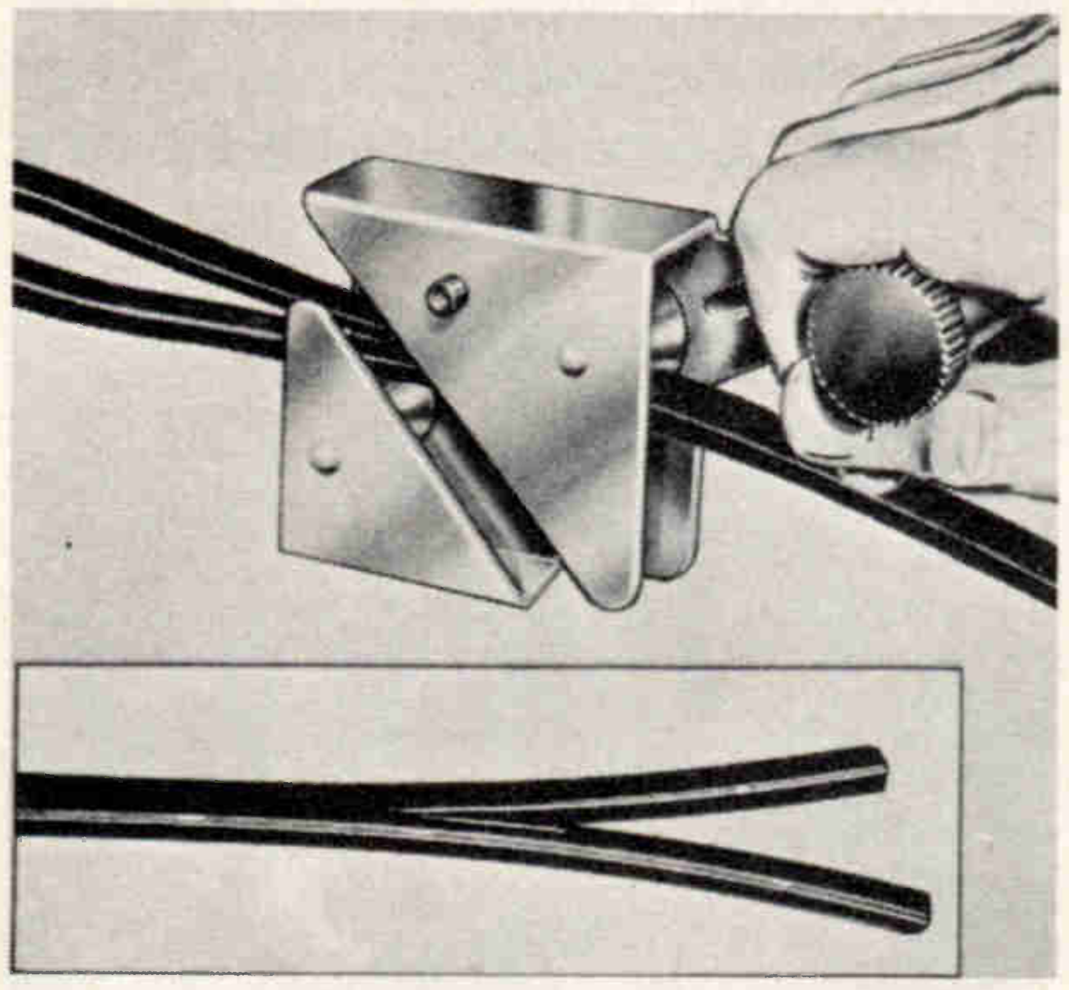
Only a single cut to the inner conductor is necessary in using this connector. No adapter of any kind is needed, and since no soldering is required, the connectors may be used over again.

The list price for the PL 259 is $1.25.

Circle 63 on literature card

Tool for Splitting Parallel Wire

P. K. Neuses has introduced a hand tool, N-2500, for slitting parallel aerial drop wire. According to the manufacturer, Model N-2500



gives optimum performance with minimum effort, even at low temperatures.

Rollers hold the cable directly in the middle of the slot in the tool to allow a sturdy knife blade to cut between the conductors for a

Circle 39 on literature card

Circle 38 on literature card

Circle 40 on literature card

straight and even split without exposing or nicking the wires.

The N-2500 is priced at $6.00.

Circle 64 on literature card

Midget Ratchet Kit

The Chapman Manufacturing Company announces the availability of its Midget Ratchet Kit No. 4320. Packaged in an easy-to-clean Vinyl, soft-pack case and designed to fit neatly into a pocket or tool box, the kit offers the additional advantage of having each component fit into its own transparent pocket.

The Midget Ratchet Kit, made to be used in hard-to-reach places, lists at $10.00.

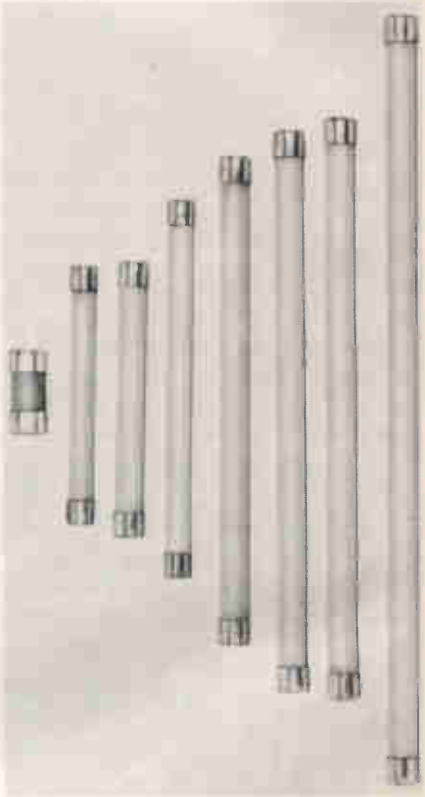
Circle 65 on literature card

Selenium Rectifiers

Rectifier Components Corp. announces the availability of low cost, high voltage, cartridge type selenium rectifiers.

The rectifier cells are made on thin aluminum base stock, which reduces the cartridge length.

Standard construction uses plated end caps and pig tail leads. The



leads may be removed for clip mounting. Lengths are dependent upon voltage requirements, which are from 800 to 20,000 volts per cartridge.

The price ranges from 30¢ to $3.00 depending on the size and quantity. ▲

Circle 66 on literature card

Erratum

The RCA part number listed for the piercing pin probe clip in Fig. 3 of the article titled "Tips and Shortcuts for More Accurate Color TV Alignment, Part 1" (July '69) is incorrect. The correct part number is **233597.**

catalogs literature

ANTENNAS

100. *Belden Corp.* — 12-page catalog covers insulation specifications and application data for Belden's entire line of lead wire for internal wiring of electrical appliances and apparatus. An index is provided for the wire illustrated in the catalog, as well as an index listing wires by Belden trade number.

AUDIO

101. *Astatic Corp.* — has published a 20-page illustrated catalog featuring descriptions and specifications for over 50 models in their line of microphones. Also included are listings of their replacement microphone cartridges and accessories.

102. *H. H. Scott, Inc.* — introduces a fully-illustrated brochure of their 1970 line of compact stereo systems, with complete descriptions of all systems and options included along with specifications and retail prices.

COMMUNICATIONS

103. *Antenna Specialists Co.* — has released a 28-page, illustrated manual entitled "Selecting Proper Antenna Systems to Meet Communications Requirements". It is a guide for selection of both base and mobile installation, with specifications and descriptions of various types of antennas included.

COMPONENTS

104. *Allied Electronics Corp.* — has introduced a 600-page book listing over 50,000 separate stock items from over 500 manufacturers. Included are prices, specifications, descriptions and illustrations of components, test equipment, tools and communication equipment.

105. *Amphenol Distributor Div. /Bunker-Ramo Corp.* — 18-page, 2-color catalog GL-2 lists thousands of individual connectors, sockets and switches now available from electronic parts distributors.

TECHNICAL PUBLICATIONS

106. *Howard W. Sams*—Literature describes popular and informative publications on radio and TV servicing, communication, audio, hi-fi and industrial electronics, including 1969 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

107. *Beckman Instruments, Inc.* —32-page Catalog 32 covers Beckman's line of insulation test equipment, electronic test and measuring instruments, high-voltage power supplies and automatic component testers. Included are technical data and specifications for each item listed.

108. *Triplett Corp.* — 2-page technical bulletin which provides complete electrical and mechanical specifications of their new digital panel meter Model 5000, with a glossary of terms included.

TOOLS

109. *P. K. Neuses, Inc.*—an illustrated 16-page catalog of small tools has been released, featuring Neuses' line of tools, with dimensions included.

110. *Skil Corp.* — has published an 8-page catalog containing 25 new Skil power products, including two saws, eighteen drills, two screwdrivers, polisher, wrench and sander.

111. *Xcelite, Inc.*—Catalog 166 Supplement, containing specifications and descriptions of an assortment of screwdrivers and nutdrivers.

*Check "Index to Advertisers" for additional information. ▲

advertisers' index

ART Electronics, Inc. 70
Aerovox Corp. 73
American Telephone & Telegraph Co. 39
Arrow Fastener Co., Inc. 68

B & K Mfg. Co.-Div. of Dynascan Corp. 1
Bussmann Mfg. Div., McGraw-Edison Co. 8-9

CRC Chemicals 6
CRT Equipment Co., Inc. 6
Castle TV Tuner Service 7
Chemtronics, Inc. 48
Cleveland Institute of Electronics 17-19
Cornell Dubilier Electronics . Cover 2

Electro-Voice, Inc. 16
Enterprise Development Corp. . . 68

Gavin Instruments, Inc. 28
General Electric Co. 43

Heath Company 65

Injectorall Electronics Corp. 71

Jan Crystals 71
JFD Electronics Co. 41

Lectrotech, Inc. 4
Littelfuse, Inc. . . . . Cover 4

Mercury Electronics Corp. . 69, 71, 72
Mid-State Tuner Service 69
Motorola, Inc. 37
Multicore Sales Corp. 24

National Radio Institute 61

Quam-Nichols Company 47

RCA Electronic Components
Entertainment Receiving Tubes . . . . Cover 3
Distributor Products 15
Test Equipment 31
RCA Parts & Accessories 45
RCA Sales Corp. 66
RMS Electronics, Inc. 70

Howard W. Sams & Co., Inc. 46
Sencore, Inc. 34-35, 50, 60, 74
Sprague Products Co. 3
Sylvania Electric Products, Inc. . 23

Triplett Corp. 67
Tuner Service Corp. 5

Ungar/Div. of Eldon Industries . . 25

Workman Electronic Products, Inc. 72

Xcelite, Inc. 47

Zenith Sales Co. 49, 55

READER SERVICE CARD

Electronic Servicing

Use the handy postage-free card below to obtain free catalogs and literature... and to subscribe or renew your subscription.

Read instructions carefully.

As a service to its readers, ELECTRONIC SERVICING makes the postpaid card below available for your convenience in obtaining current manufacturers' literature.

To use the card, simply:

a. Circle the numbers corresponding to the numbers of the items about which you would like to receive additional information.
b. Print your name and address and check your occupation.
c. Include ZIP code—requests may not be filled without it.
d. Tear out lower half of this insert and place in mailbox.

Note the deadline date—Requests received after this cannot be filled.

▼ Free catalogs & literature

Subscribe or renew your present subscription to the nation's favorite electronic servicing magazine . . . ELECTRONIC SERVICING (formerly PF REPORTER).

Now with expanded editorial coverage of the entire electronic servicing business, ELECTRONIC SERVICING is more valuable to you than ever! Monthly it brings you the latest solutions to service problems on home entertainment electronics, including concise, timely coverage of new testing methods, product reports and practical service procedures!

Start ELECTRONIC SERVICING coming by sending in this postage paid order form . . . TODAY!

▼ Subscription offer

OCTOBER, 1969

OFFER EXPIRES JANUARY 1, 1970

Please indicate number of items you have circled → ☐

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126
127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162
163	164	165	166	167	168	169	170	171	172	173	174	175	176				

Print plainly or type below:

Name ....

Firm ....

Firm Address ....

City.......... State.......... Zip..........

Did you receive this issue through ☐ Distributor ☐ Subscription

Subscription Offer

Enter my subscription to ELECTRONIC SERVICING

☐ 3 Years $10.00 ☐ 2 Years $8.00 ☐ 1 Year $5.00

☐ Bill Me ☐ Remittance Enclosed ☐ Extend Present Subscription

IMPORTANT! Please check your business classification.

Type of Business

Check One

A. ☐ Independent Electronic Service Organization
B. ☐ Retailer with Electronic Service Department.
C. ☐ Independent or Self-Employed Service Technician
D. ☐ Electronics, Radio, TV Manufacturer
E. ☐ Industrial Electronic Service
F. ☐ Wholesale, Jobber, Distributor
G. ☐ Other (Specify) ....

Position

Check One

H. ☐ Owner, Manager
I. ☐ Ser. Manager
J. ☐ Technician
K. ☐ Other

Be sure you have checked one box in each column above!

FIRST CLASS
PERMIT NO. 217
CLINTON, IOWA

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

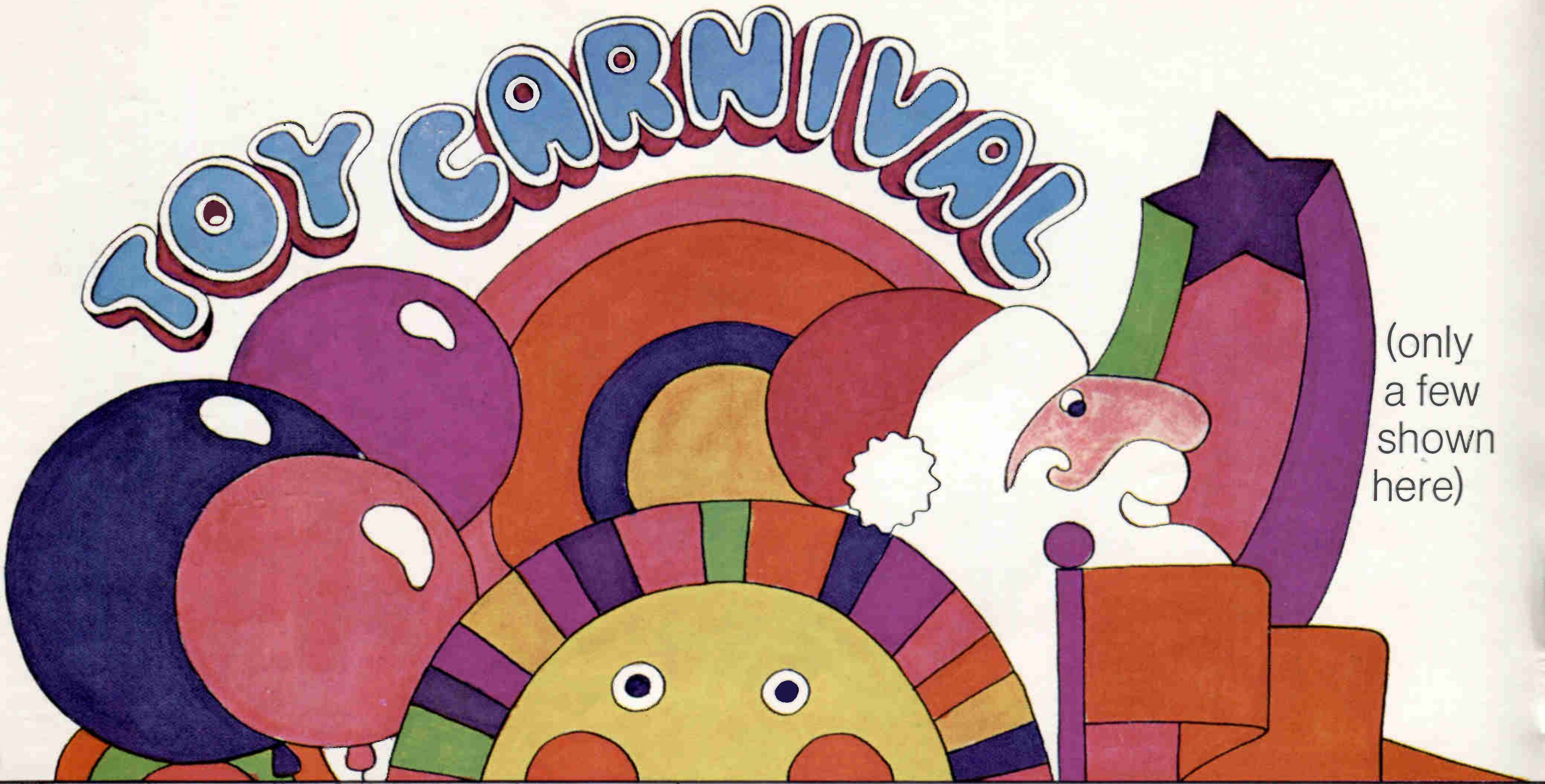
Postage Will be paid by

Electronic Servicing

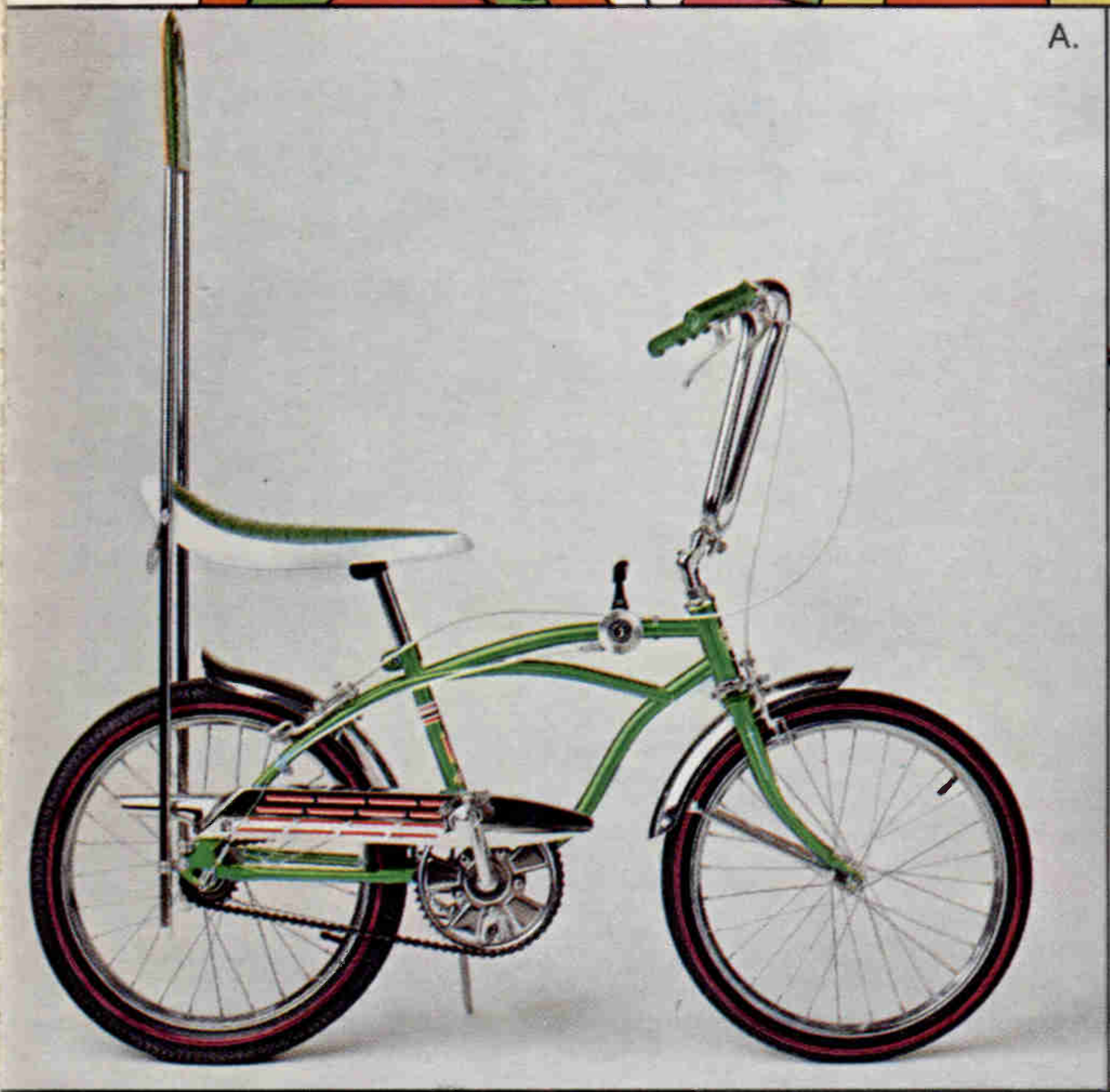
P.O. Box 2609

Clinton, Iowa 52732

COMING YOUR WAY FOR CHRISTMAS '69 RCA'S

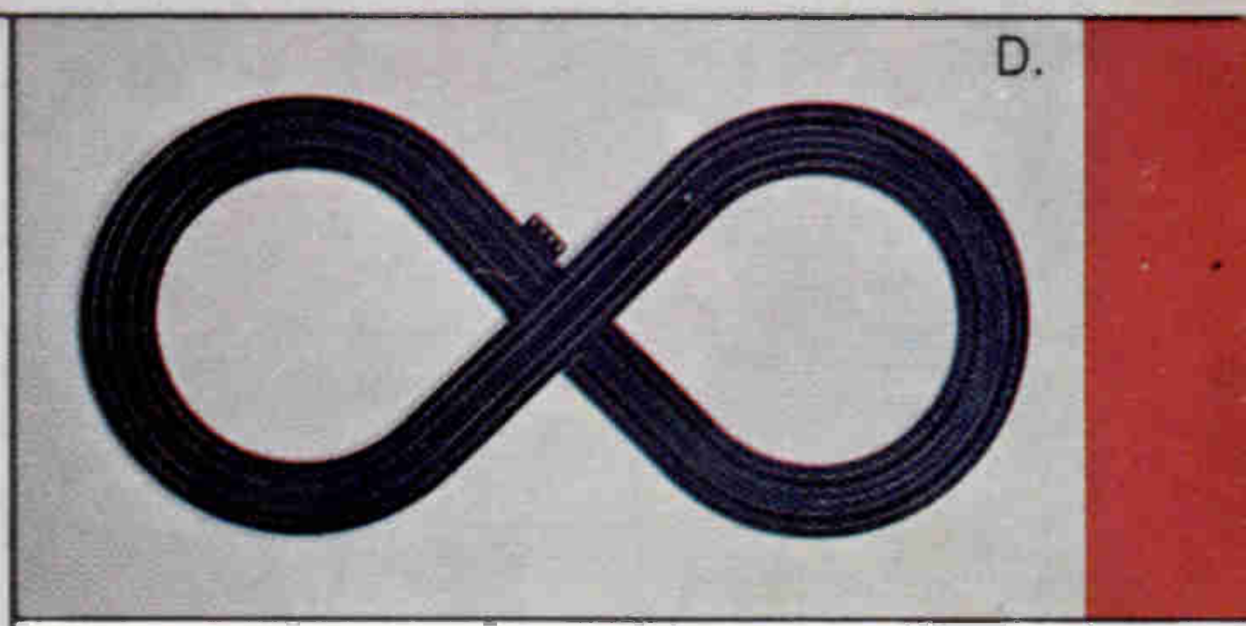


(only a few shown here)

A.


B.


C.


D.


* 17 wondrous toys (only a few shown here) to light up the eyes of children of all ages!
* available with purchases of RCA Entertainment Receiving Tubes and Picture Tubes from your local participating RCA Tube Distributor.

E.


F.


G.


H.


I.


A. HUFFY BOY'S BICYCLE "DRAGSTER III"—TC-2044—3 speeds
B. ATLAS N-GAUGE READY-TO-RUN TRAIN SET—TC-69364—complete
C. PLUSH DOG—TC-2262—cute-as-a-button beagle type
D. ATLAS ROAD RACING-SET—TC-1202—complete with power supply
E. PARKER "QUBIC" GAME—TC-400—3-dimensional Tic-Tac-Toe
F. COLLECTOR'S SET AMERICAN SPACE PROGRAM BY REVELL—TC-1839—3 ready-to-assemble models
G. HORSMAN "BABY BUTTERCUP" DOLL—TC-5301—drinks and wets
H. MIGHTY-TONKA DUMP TRUCK—TC-3900—a kid can ride it
I. HORSMAN "BABY TWEAKS"—TC-2570—18″ tall, she "coos"

See your participating RCA Tube Distributor for details

RCA Electronic Components, Harrison, N.J. 07029

RCA