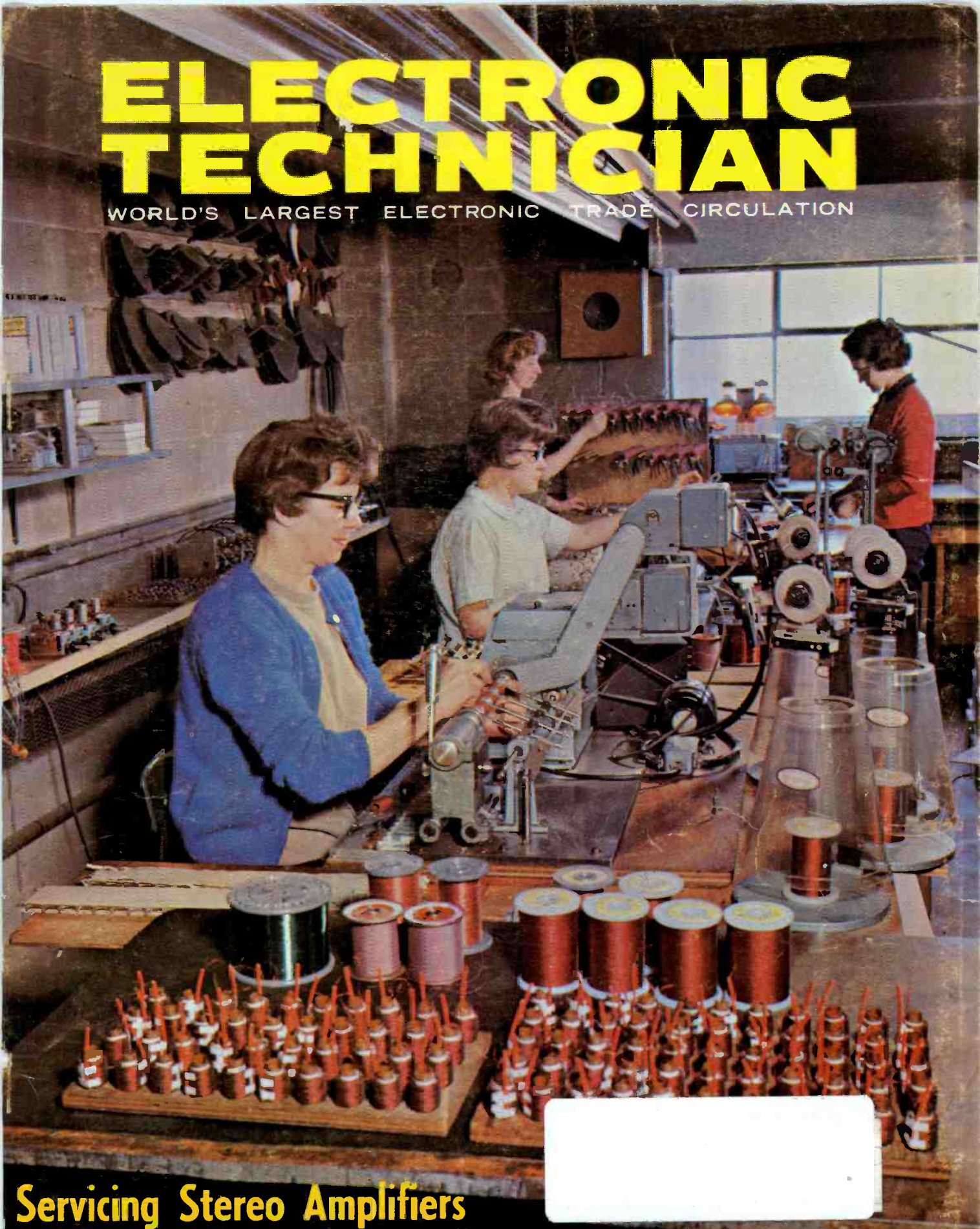
ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION



Servicing Stereo Amplifiers

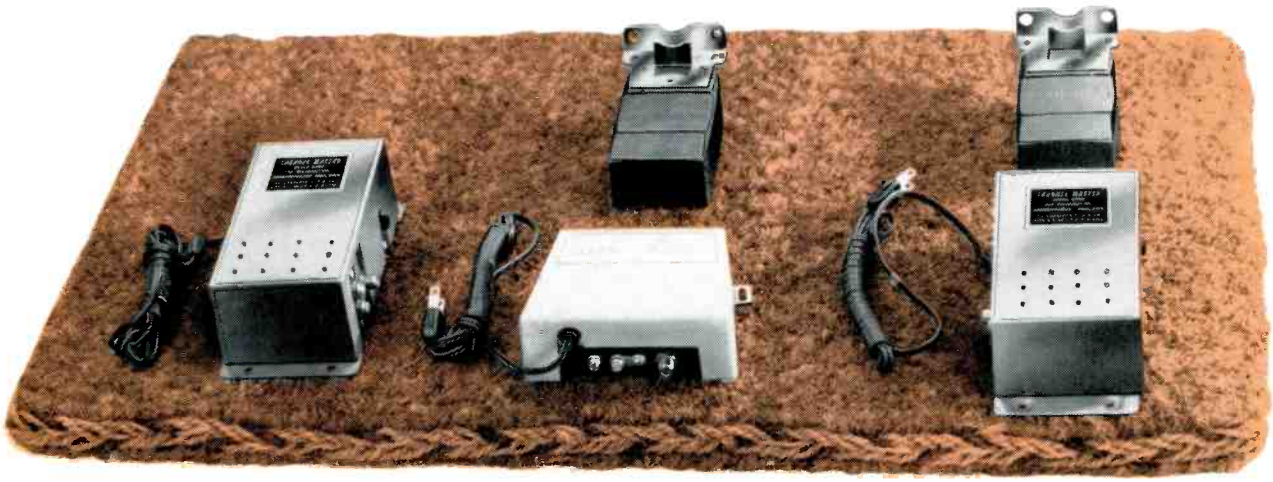
Volume Limiting in PA Systems

Transistors — Diodes — Negative Resistance

AN OJIBWAY PUBLICATION

MAY 1966

Small homes are saying "Yes" to big MATV business.



Walk right in with one of our 5 brand-new Channel Master MATV Amplifiers*

(They're priced fantastically low).

The color explosion has given birth to a gigantic new market. One that's left the door to multi-set homes wide open for big business opportunities.

When a family buys a color set, they don't throw the old black-and-white console away. They keep it. Chances are they also own a portable and even an FM set or hi-fi.

All this means one thing: Every one in your neighborhood who has, or buys, a color set becomes a hot prospect for the unique room-to-room flexibility offered by a Master Antenna Home System.

Here's where you cash in with our big line of Channel Master MATV amplifiers. They let you accommodate the **exact** need. For instance: Our new solid state VHF/FM Color Amplifier (Model 7035) provides 15 db across the entire band, flat color response, 1.5 volt output capability, plus a 75 ohm or 300 ohm input or output. It could be perfect for a home with a number of outlets in a weak to medium signal area.

Or the situation may call for one of our two new 75 ohm coaxial boosters: the single transistor Telstar VHF/FM (Model 0043); or the 2-transistor Twinstar VHF for areas with overload problems (Model 0041). Both models provide especially high gain (15 db) and low noise figures—and are the **only** coaxial amplifiers with both a 75 ohm and 300 ohm output.

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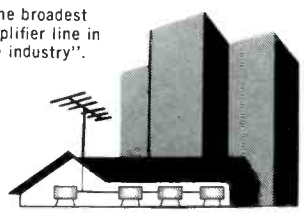
We have other amplifiers, including several for medium and large commercial systems. But the important thing is our flexibility. You're backed by the broadest MATV amplifier line in the business.

Like we said: The welcome mat is out. What are you waiting for?

Write for the facts!

* MODEL	GAIN	NOISE FIGURE		MAXIMUM INPUT SIGNAL IN MICROVOLTS		OUTPUT CAPABILITIES		LIST PRICE
		LOW BAND	HIGH BAND	LOW BAND	HIGH BAND	LOW BAND	HIGH BAND	
7035 Color Amp	15 db	2.5	5.4	300,000 total		1.5v total		Only $34.95
0043 Telstar	15 db	2.2	3.0	15,000	30,000	100,000	135,000	Only $34.95
7043 Color Tandem	30 db	2.2	3.0	15,000	30,000	1.5v total		Only $64.95
0041 Twinstar	15 db	2.5	3.7	150,000	190,000	850,000	600,000	Only $44.95
7041 Color Tandem	30 db	2.5	3.7	60,000	100,000	1.5v total		Only $74.95

"The broadest amplifier line in the industry".



CHANNEL MASTER

ELLENVILLE, NEW YORK

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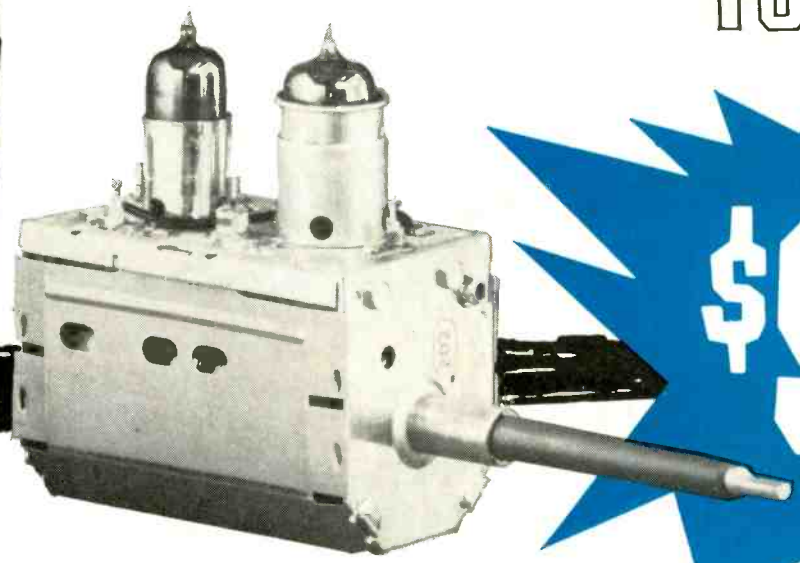

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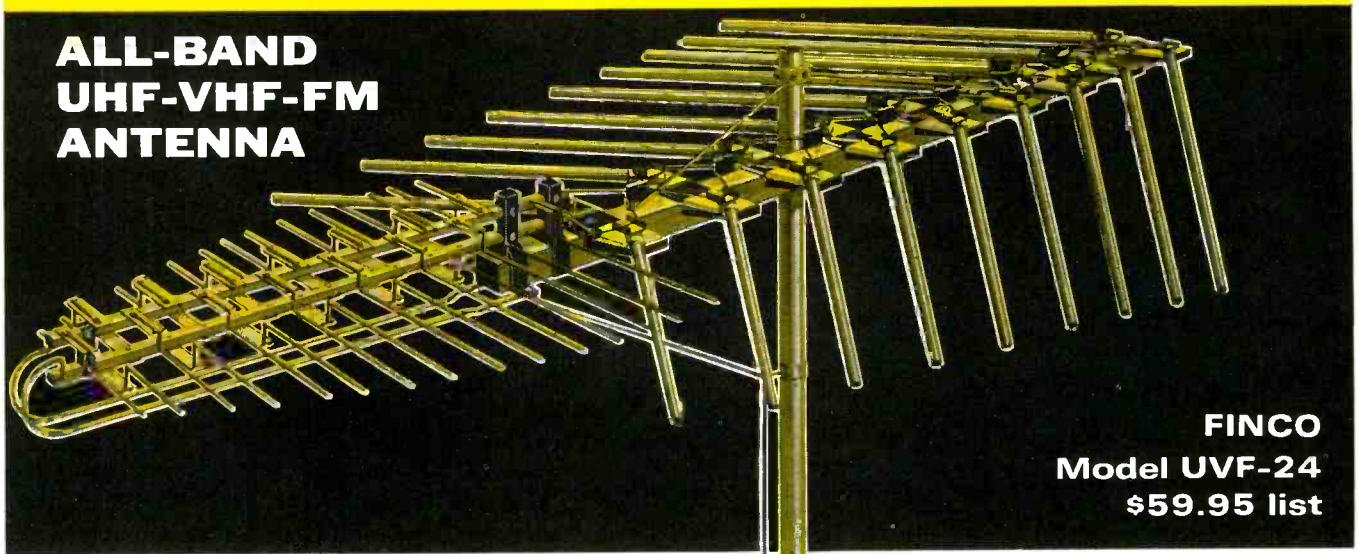

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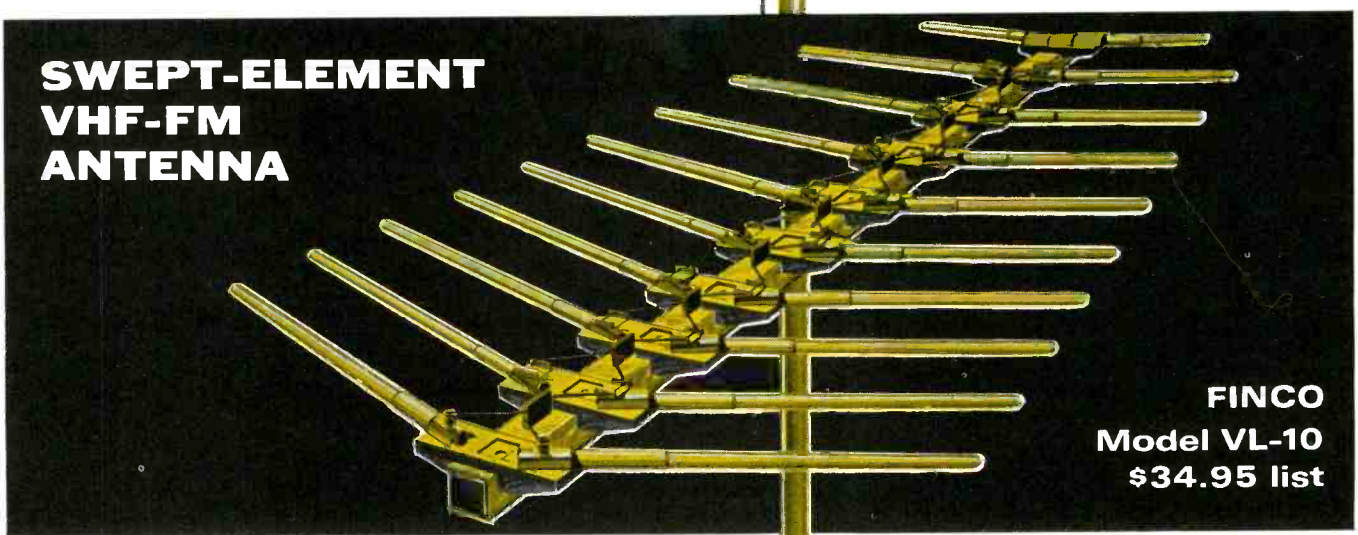

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MAY 1966
VOL. 83 NO. 5

ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

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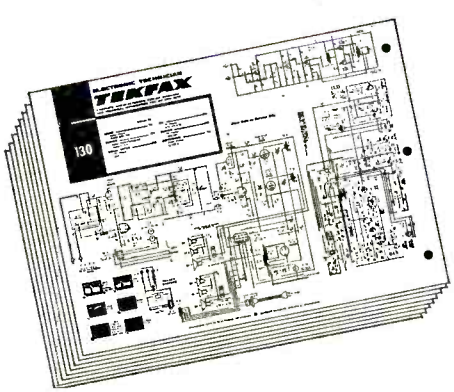
Cover

Increased demand for color and monochrome TV sets has created an immense need for more TV components. Our cover shows a flyback transformer winding machine in one section of a midwest TV manufacturer's plant.

FEATURES

DEPARTMENTS

TEKFAX ____ 16 PAGES OF THE LATEST SCHEMATICS



Group 165 — May • 1966

AIRLINE: TV Model Gen-1866A

EMERSON: TV Model 9P50

GENERAL ELECTRIC: TV Chassis TV

PHILCO: TV Chassis 15J25

RCA VICTOR: TV Chassis KCS136M

SEARS-SILVERTONE: TV Model 6122

WESTINGHOUSE: TV Chassis V2487 Series

ZENITH: TV Chassis 16N24

LETTERS TO THE EDITOR

Le Coq Again

Hats off to Willy Le Coq. I am also fed up! The TV sets are designed for eye appeal but not for repairing. Some are almost impossible to service . . .

RAY LAWRENCE

Sheboygan, Wis.

Sees Two Sides of ET

I gave the January issue of ET the usual cover-to-cover treatment. It is, as usual, an excellent issue; a little more 2-way radio than I care for but that's a matter of what you're most interested in . . . I noted a couple of highlights and a couple of chuckles. In "Letter to the Editor," we have a story about that hardy perennial, the TV set placed under the furnace thermostat. I don't doubt the story: it has happened too often. Twice in my town to my certain knowledge and this is a small town. But that was long ago when the only TVs in town (regardless of the brand name) were RCA 630s, DuMont 103Ds and an occasional Capehart "coffin" with the piggy-back sync chassis. These jobs all drew 300-plus w and when you parked *them* under a thermostat, it got real cool in the house. That has become a standard part of modern American folklore—like the TV antenna that blew off a 100ft mast, stuck in the back yard and they built a fence around it and left it that way because it gave better reception . . . It looks like a new generation has sprung up and the old lessons must be re-learned . . . The other chuckle was Mary Irving's excellent idea of using drawstring bags to hold parts. I know how she feels: I've been there, too. When I was a kid in school I "invented" a multi-contact knife switch only to learn that it had been patented twenty years before I was born. Mrs. Irving's idea is *good*. So good that Sylvania handed out a flock of those bags completely imprinted shortly after W.W.II. I enclose a sample, a little discolored with age, but still in good condition . . . Please don't think I'm poking fun at these good folks. What they said was accurate and in good faith. But I am amused by the cycles (Hertz) that constantly reappear in all things . . . I enjoyed your excellent article on the Hickok 662 color generator. It was complete and well written . . . I took careful note of the Hickok DMS-3200 ad also . . . This is the first low-priced digital readout unit I've seen . . . Finally, my card is enclosed for information requests. This is one of the best methods for getting the advertising matter you want when you want it so your file on new products is kept up to date. I use it a great deal . . . Thanks for your excellent service and please keep up the good work.

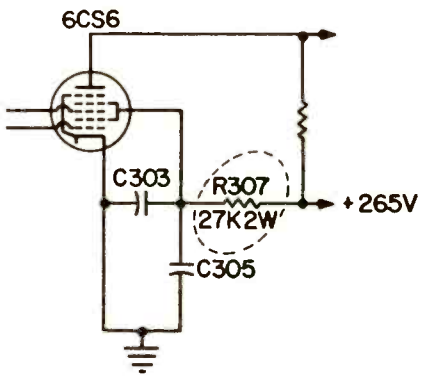
FRANCIS C. WOLVEN

Saugerties, N.Y.

Look Closer

Some ET readers may find this one helpful.

When we looked at this Sylvania 575-3 series TV chassis in the customers home, it had a sync problem. Both vertical and horizontal sync were out. Replacing a 6CS6 sync tube corrected this but left a "breathing" problem and the B+ voltages were not correct. We thought it was a filter problem. Close visual examination, however, showed a burned 27K 2w resistor (R307). It had also unsoldered itself from the printed circuit board by overheating and because of bent leads the resistor still made connection. An ohmmeter check showed it had changed value to 1K. I checked



C303 and C305 (as shown in schematic here) but found they were good. Replacing the 6CS6 and the resistor corrected what looked like a filter problem. Apparently a short in the tube caused the resistor to go bad, we couldn't determine this. The point is, visual inspection saved us a lot of time at the bench.

JIM BISHOP

Bennington, Vt.

Offers Service Manual

I have a service manual on the RCA audio chanalyst model 170A if any one needs it. Last October marked 40 years we have been in this business and we're still going strong!

ED SCRIBNER

Schoharie, N.Y.

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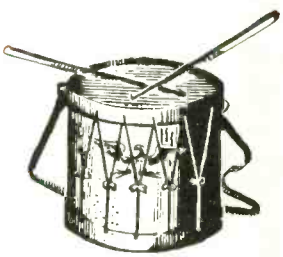

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LETTERS TO THE EDITOR

Not Favorably Impressed With In-Home Servicing

Just finished reading your feature on "In-Home Servicing" appearing in the February issue. I couldn't help laughing . . . I will go along with the idea that 9 out of 10 sets can be repaired in the home if you have 2 or 3 calls per day and if you are a real sharp technician and then only if you work on only one brand of TV . . . If a service technician maintains a full stock of tubes and parts, he'll *have* to repair the set in the home — he won't have room in his truck to haul it to the shop . . . I have worked on lots of these so-called repaired sets in the home and I have yet to find one that is fixed right or a customer that was satisfied . . . Let me tell you the way we run a two-technician shop and what I think is the proper way: If a tube or tubes will not correctly repair the set, the technician brings it to the shop. There a teenage boy (any shop without an apprentice is not worth its salt), removes the chassis, cleans it, checks all tubes, cleans the tuner and places the chassis on the work bench. The bench technician properly repairs the set using the proper test instruments designed for the job. He then places the set on another bench to cook for 4 of 5 hours to find any other faults. The apprentice then cleans the CRT and cabinet glass and reinstalls the chassis in the cabinet, puts the back on the set and operates it for 2 or 3 hours more to make sure no parts break down from heat. The set is then returned to the customer. You feel reasonably sure there will not be a callback. By operating in this way, the outside technician can make from 10 to 15 calls a day, the benchman can repair from 4 to 8 sets, all the walk-in business has been properly taken care of and you are training another technician so when business improves, you have a man to take care of it . . .

BILLY HATFIELD
Nicoma Park, Okla.

Needs Rainbow Pattern Adapter

I'm looking for an adapter to add a rainbow pattern to my Hickok 660 dot/bar generator. Can any ET reader help me?

ALLAN M. HARD
Demopolis, Ala.

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EDITOR'S MEMO

Through the Jungle

Just where the first vine was planted in the jungle of solid-state gobbledygook isn't easy to determine. But after doing a three-month research stint — macheting our way through the solid-state jungle-growth of books and technical magazine articles — we did develop a healthy respect for a handful of writers who blazed a few trees that lead us through the maze of twining double-talk, confusion, contradiction and ambiguity.

It is amazing how little has been communicated in so many words about solid-state circuitry. No wonder many technicians have developed a fear of servicing it. How did all this come about? It would take a full-length book to tell.

One thing seems certain: As far as working technicians are concerned, the knowledge-explosion in solid-state technology has come from a sawed-off shotgun! The shot got all mixed up with the wadding and went every-which-way.

Information that concerned only the chemist, the physicist, the design engineer and the manufacturer got mixed up with (and all but submerged) the practical aspects of concern to those of us who service equipment.

But this "confusion" will not be allowed to continue. A number of TV manufacturers have already caught up with the situation, and their technical literature is showing a glimmer of light through the twisted jungle vines. ELECTRONIC TECHNICIAN, too, has engaged a group of knowledgeable field engineers and technicians, who are also experienced writers, to prepare down-to-earth articles on this subject. And we've set aside an area in our expanding TEKLAB to actively pursue solid-state servicing techniques and how best to approach problems that arise in semi-conductor equipment.

In the meantime, to those who are not experienced with transistors, we would like to recommend that you do not attempt to learn about them by comparing them with tubes. They are not like tubes and do not work like tubes. To compare them with tubes creates much confusion.

If you have solid-state troubleshooting and repair problems, let us know about them. We intend to help you find your way through this man-made jungle.

WESTINGHOUSE

TV Chassis V2483-1—Power Supply—Circuit Operation

The power supply circuitry, as incorporated in this portable transistor television receiver must supply the following three levels of dc voltage: (1) An unregulated 250v for the video output stage. (2) A regulated 60v for the audio output, vertical output and horizontal driver and output transistors. (3) A regulated 12v for the remainder of the signal circuits.

The power transformer, which is connected to the 120vac line, is tapped at three different levels. One tap supplies the voltage for the CRT heater, the next tap feeds into the 250v rectifying circuit and the third is for a full-wave circuit which supplies 75vdc to the regulator circuitry. This voltage regulator produces the +12 and +60 regulated voltages.

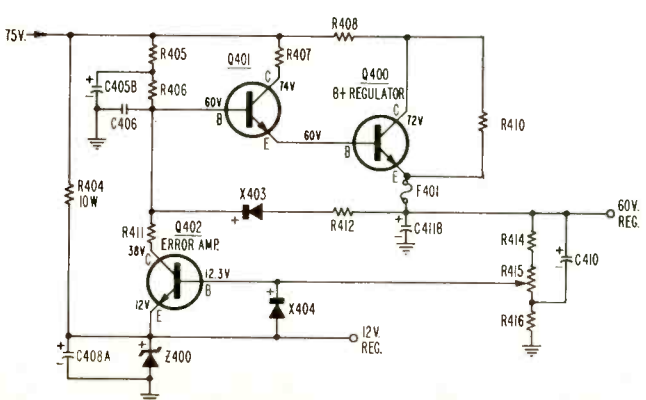
The 250v supply is provided by the conventional type half wave rectifier. Switch SW400A completes the circuit by returning the secondary of the 250v transformer winding to ground. AC ripple is filtered out by the pi-type configuration consisting of two 100pf electrolytic capacitors and a power resistor.

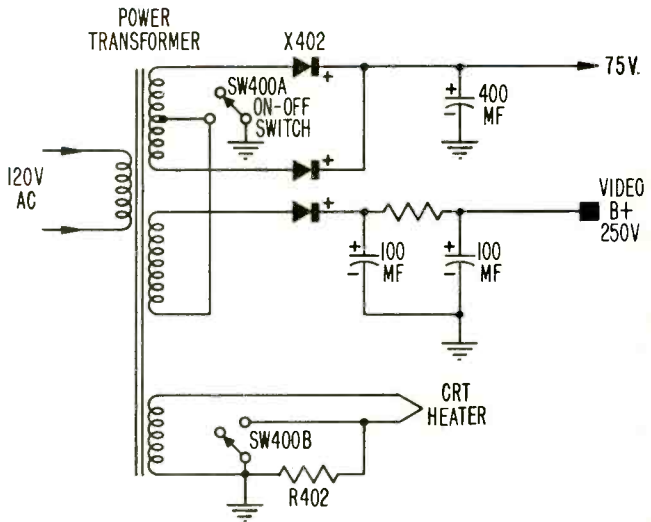
The second B+ circuit is a conventional full wave rectifier utilizing a single 400pf electrolytic capacitor for filtering out any ac ripple. The output of this circuit is a possible 75v which is applied to the voltage regulator circuitry.

Voltage Regulator

For proper operaton transistor circuits require well regulated supply voltages. Regulation protects the transistors if the line voltage is too high, too low or subject to surge. Input to the regulator circuits is 75v, providing for the 12 and 60v regulated output.

The 12v output is regulated by the use of a zener diode. A zener diode conducts heavily in a reverse bias direction when the potential across it exceeds a specified level. This is called the breakdown voltage. Zener diode is a 12v device that has the characteristic of maintaining 12v across itself regardless of the amount of current flowing through it. The 75v input to the circuit is applied across the series combination of resistor R404 and zener diode Z400. The emitter of the error amplifier (Q402) is connected to the junction of these two components. The impedance of the zener diode is such that the 75v will divide down to 12v at the emitter of Q402. If the 75v should increase. The zener diode impedance would decrease. (due to breakdown) thereby conducting more current and maintaining the emitter. The regulated 12v is





used both by the signal circuits in the receiver and by the 60v regulator as a reference level.

The base of the error amplifier Q402 is connected to the 75v source voltage, through the tap on control R415, and resistors R414, R410, and R408. This dividing network results in approximately 12v at the base of the error amplifier. If the voltage increases, the base emitter junction of Q402 will become forward biased resulting in an increase of collector to emitter current through this transistor. This increased current will effect the voltage drop across resistors R405, R406 and R411 in such a way as to keep the voltage on the base of Q401 at a constant 60v. For example: If the 75v supply voltage should drop, the voltage on the base of the error amplifier (Q402) would decrease. This decreased voltage would result in an increase of the internal impedance of this transistor and an increase in the voltage at the base of Q401. If the supply voltage should rise above 75v, transistor Q402 would conduct more heavily resulting in a lower voltage at the base of Q401, thereby correcting for the original increase.

Controlling the base voltage of Q401 automatically controls the base voltage of the series regulator power transistor Q400 through the low impedance of Q401's base-emitter junction. This voltage control of the base of Q400 permits regulation of its collector-emitter current. Most of the current required by the 60v circuits flows through this transistor. It is for this reason that this transistor is a high power type and is mounted on a heat sink on the left side of the chassis. The outer case and the two connecting screws of the transistor have a potential of 60v on them and carry collector current. Not all the current for the 60v circuits flows through the series regulator transistor. For dissipating a higher-line voltage R410 (47 15w) is connected in parallel with Q400. If a short occurs in the 60v circuits, the fuse in the emitter of Q400 would open.

The two diodes, X403 and X404 are protective devices. Diode X403 is in parallel with the combined base-emitter circuits of Q401 and Q400 to prevent a reverse bias condition from damaging these transistors. If, for any reason, the base of Q401 should attempt to go less than 60v, causing a reverse bias condition, diode X403 would start conducting to prevent damage to the tran-

sistor junctions. Diode X403 is connected in such a manner that it will conduct only if the base of transistor Q401 attempts to go less than 60v. Diode X404 performs a similar function. It will become forward biased if the base of Q402 should attempt to go below 12v. The resultant shunting of current through the diode would serve to protect error amplifier transistor Q402.

OLYMPIC

Color TV Chassis—CTC17 and CTC18—Circuit Modification

If any models using these chassis have insufficient width, ringing bars at start of sweep on left side of raster and/or excessive blooming the following steps should be taken to correct the fault: (1) Connect 100 pf 5kv disc capacitor between pins no. 2 and no. 9 on 6DW4 damper tube. If this value is not available it is possible to substitute Olympic part no. CO-32092-27, 130pf 6kv disc capacitor. If width is increased too much connect 2-130pf capacitors in series (65pf total). (2) Replace 6JE6 and 3A3. (3) Turn brightness up to maximum and then reduce to normal viewing level. (4) Adjust high voltage control for minimum blooming and optimum brightness. (5) Adjust focus control for best focus in center of screen. (6) If the screen controls (red, blue, green) have been misadjusted, it will be necessary to repeat screen adjustments as indicated in service manual. (7) Bias switch should be checked for best operation when setting screen controls.

GENERAL ELECTRIC

TV Chassis AA and AB—Horizontal Hold

The horizontal pull-in range of the AB chassis is normally 3 to 5 bars from either side. On some receivers this range may be less, due to accumulated tolerances of components. This may create a problem of frequent hold control re-adjustment in critical reception areas. Basically proper pull-in range is dependent upon proper adjustment of the horizontal frequency circuit and proper balance of the phase detector. The horizontal frequency adjustment should be performed according to the service manual. If the receiver has insufficient pull-in range after completing the frequency adjustment, the following is recommended.

Change capacitor C252 from 47 to 68pf to correct the balance of the phase detector. This capacitor is available from the top of the chassis and it will usually be more convenient to add an extra capacitor of from 18-24pf across the existing C252.

If a soldering iron and extra capacitor are not available, the following, slightly less effective cure (which will probably prove adequate in the majority of cases), may be used. As an additional step to the routine set-up of horizontal frequency, short the clipper grid to ground and adjust the horizontal hold R257 until the picture floats across the screen. Remove the short and check performance.

This information is not only applicable to the AA and AB chassis but may be used in troubleshooting the horizontal circuits of other chassis employing this type of phase detector and multivibrator horizontal oscillator.

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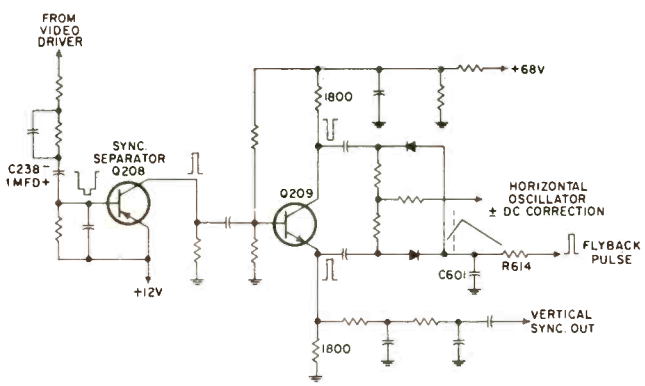
TECHNICAL DIGEST

MAGNAVOX

TV Chassis T908—Sync Stages—Circuit Description

The video signal from the video driver stage is coupled to the base of the sync separator. With no signal present, Q208 is cut off since there are no provisions for forward biasing the base-emitter junction. However, when a signal is received, the negative-going sync tips forward bias the PNP transistor into conduction. Base current flows and charges C238 as shown. The capacitor charge tends to reverse bias the base-emitter junction so that only sync tips are able to turn on the transistor. Strong signals would charge the capacitor still more, further increasing reverse bias, and allow only the sync tips to be amplified. The operation of this circuit is exactly the same as the grid leak bias method used in tube circuits.

The amplified sync pulses are inverted in the collector circuit and coupled to the base of Q209. Q209 is a sync splitter stage. Equal amplitude but opposite polarity



pulses are developed at the collector and the emitter. This occurs due to the equal value load resistors in the collector and emitter (1800Ω). The positive emitter signal is integrated in a dual section filter network into a 60Hz or vertical sync pulse which then controls the frequency of the vertical oscillator. Both the emitter and collector sync pulses are coupled to the AFC diodes to develop a dc control voltage for the horizontal oscillator. These two signals are compared to a third signal supplied by a winding on the flyback transformer. The flyback pulse is integrated into a sawtooth waveform by R614 and C601. When the oscillator is exactly on frequency the accumulated charge on the two sync coupling capacitors are equal but opposite in polarity. The two charges just cancel each other at the junction of the three resistors so that zero correction voltage is produced.

Should the oscillator shift frequency slightly, the sawtooth waveform at the diodes will advance or retard in phase. This allows one diode to conduct more while the other diode conducts less. The diode that conducts more, charges its coupling capacitor to a higher level while the other diode develops a smaller charge on its coupling capacitor. The net voltage at the junction of the three resistors will no longer be zero but will take on the polarity of the capacitor having the most charge. This resultant voltage, which may be positive or negative, is then used to correct the frequency of the horizontal oscillator.

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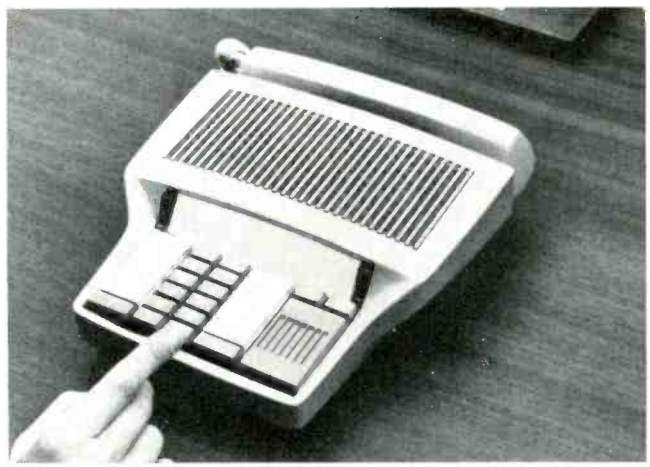
SYNC ON BUSINESS

A "touchdial" telephone system has no receiver to hold and the manufacturer says it's five times faster than dialing a regular telephone. Other buttons provide "hot



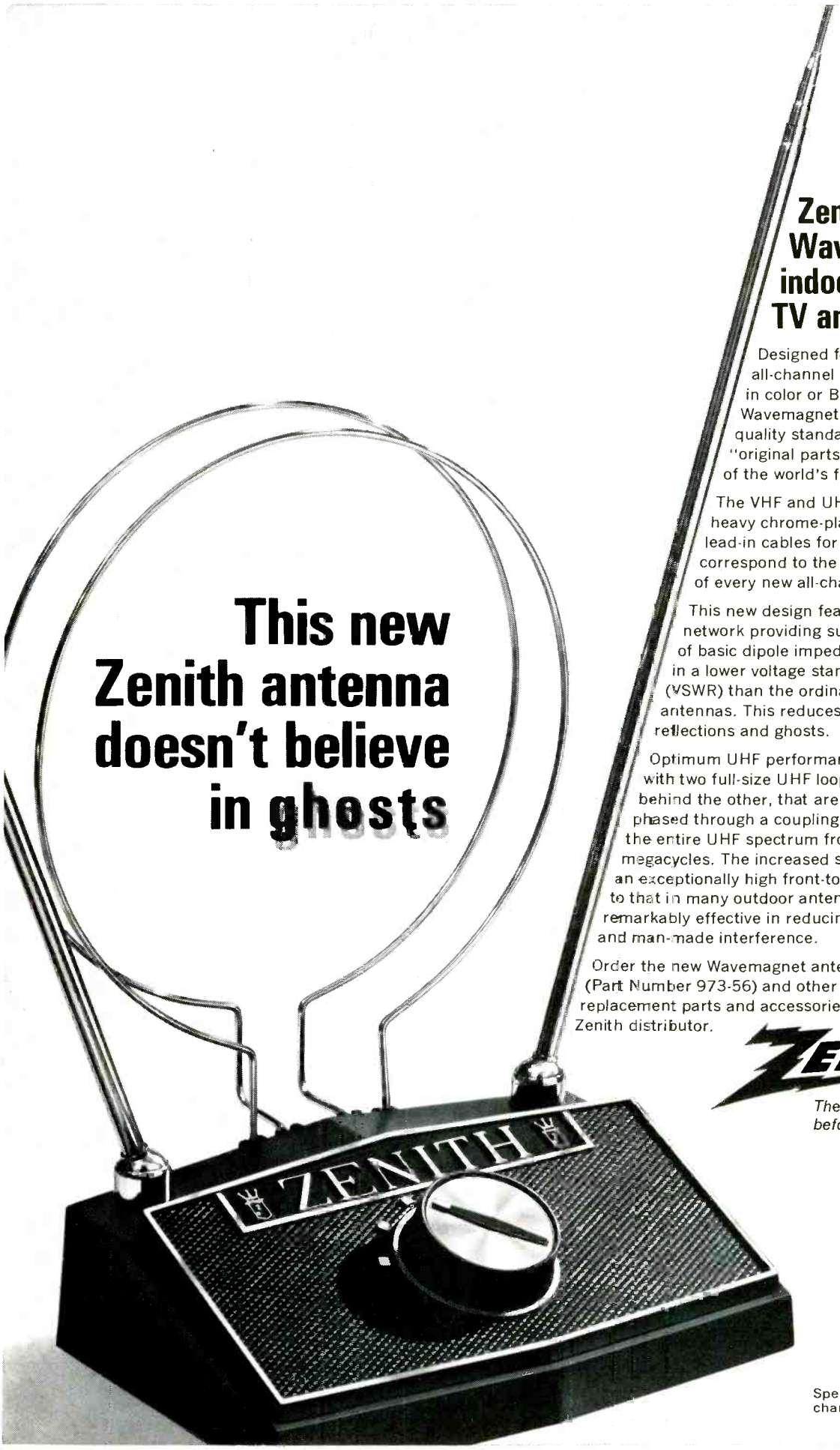
lines" and "private" operation of the master station plus "secretary transfer" button. Write Action Systems Co., 34 Cambridge St., Meriden, Conn., for further information.

• • •

The 1966 Magnavox spring service conference series is continuing. Remaining areas scheduled for meetings are: **Cedar Rapids, Iowa,** June 1, **Davenport,** June 3, **Des Moines,** May 26. **Louisville, Ky.,** May 5 and 6. **Portland, Me.,** June 1. **District of Columbia, Washington,** May 10 and 11. **Boise, Idaho,** May 12, **Idaho Falls,** May 18. **Detroit, Mich.,** May 10 and 11, **Grand Rapids,** May 20, **Saginaw,** May 17 and 18. **Minneapolis, Minn.,** May 18 and 19, **Rochester,** May 24. **Helena, Montana,** May 20. **Albany, N.Y.,** May 17 and 18, **Buffalo,** May 24 and 25, **Rochester,** May 20, **Syracuse,** May 27. **Raleigh, N.C.,** May 23, **Charlotte,** June 2. **Fargo, N.D.,** May 16. **Cincinnati, Ohio,** May 10 and 11, **Toledo,** June 1 and 2. **Eugene, Ore.,** June 3, **Portland,** May 31 and June 1. **Philadelphia, Pa.,** May 3, 4, 5 and 6. **Columbia, S.C.,** May 25. **Johnson City, Tenn.,** May 31. **Salt Lake City, Utah,** May 9 and 10. **Norfolk, Va.,** May 20, **Richmond,** May 18. **Seattle, Wash.,** May 25 and 26, **Spokane,** May 23, **Tacoma,** May 27. **Charleston, W. Va.,** May 13. **Green Bay, Wis.,** May 26, **Madison,** May 24. Dates are subject to change so check with your Magnavox distributor.

• • •

Lear Jet 8-track auto tape cartridge players are available from 19 more distributors across the country. They include: Main Line, Cleveland; Main Line Record Service Co., Miami; Associated Distributors, Inc., Indianapolis; Interstate Distributing Co., Billings; Dulaneys, Oklahoma City; Arizona Sundries, Phoenix; Grabar Electric Co., Wichita; Houston Air Center, Houston; Perry Shankle Co., San Antonio; Ward Terry & Co., Denver; Interstate Supply Co., St. Louis; Thoben-Elrod, Atlanta; Lewis Bear Co., Pensacola; Commercial Distributors, Inc., Portland, Me.; Jack H. Samuels Co., Pittsburgh; Memphis Aero, Memphis; Advanced Stereo, Inc., Dallas; D & H Distributing Corp., Harrisburg and Taylor Electric Co., Milwaukee.



This new Zenith antenna doesn't believe in ghosts

Zenith Wavemagnet® indoor TV antenna

Designed for clear, sharp, all-channel (2 to 83) reception in color or B&W, the Zenith Wavemagnet antenna meets the quality standards set for Zenith "original parts"... your assurance of the world's finest performance.

The VHF and UHF elements are heavy chrome-plated. Separate lead-in cables for UHF and VHF correspond to the input arrangement of every new all-channel TV receiver.

This new design features a special network providing substantial step-up of basic dipole impedance, resulting in a lower voltage standing wave ratio (VSWR) than the ordinary VHF indoor antennas. This reduces snow effect, reflections and ghosts.

Optimum UHF performance is achieved with two full-size UHF loops, arranged one behind the other, that are carefully phased through a coupling network through the entire UHF spectrum from 470 to 890 megacycles. The increased sensitivity develops an exceptionally high front-to-back ratio equal to that in many outdoor antennas. This is remarkably effective in reducing ghosts and man-made interference.

Order the new Wavemagnet antenna (Part Number 973-56) and other genuine Zenith replacement parts and accessories from your Zenith distributor.

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SYNC ON BUSINESS

Experimenters kits are also available from G-E. Contact your General Electric electronic components distributor, or write G-E Electronic Components Div., 5504 S. Brainard Ave., La Grange, Ill.

• • •

A 96-page twist-prong electrolytic reference catalog is available at your Cornell-Dubilier distributor. It has been designed to solve major problems facing service technicians in electrolytic replacements.

• • •

An SWR meter for checking the mismatch between transmitters and receivers is available from E. F. Johnson Co., Waseca, Minn. Measures mismatch up to 10:1, maximum power up to 500w modulated, requires 2w power at 27MHz. Unit is equipped with coax connectors.

• • •

A "Handbook of Electronic Charts and Nomographs" is now available. Contents of the 58 nomographs and charts range from simple arithmetic to computation of phase angle-resistance, capacitance and inductances in parallel. Includes explanatory text and sample formula solutions that are easy to follow. Write for more information to TAD, Inc., 639 Massachusetts Ave., Cambridge, Mass. 02139.

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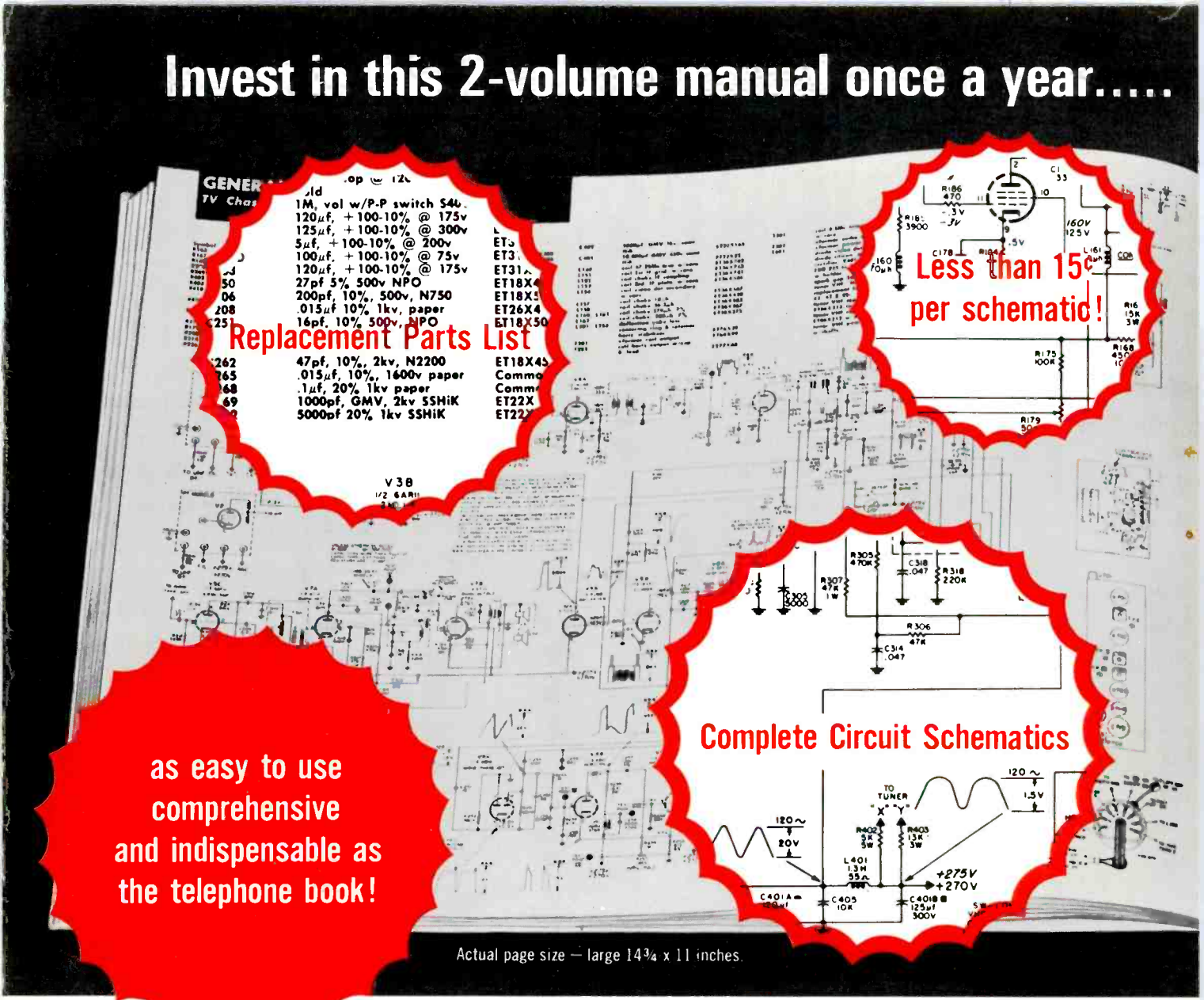

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ANNOUNCING...

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☐ *What it is.* The first in an annual series of permanently bound information "packages" for the active television technician. It provides complete schematics and vital servicing data for every 1965 TV receiver produced by the leading American manufacturers. (See this year's list of 23 makers.) As an extra bonus, this first TV Tech/matics also covers all color sets made from 1960 to 1965.

☐ *Is it a reliable source?* All of the Tech/matics diagrams and service data are based on the original manufacturer's specifications — compiled and organized by the expert editorial staff of *Electronic Technician* magazine.

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☐ *Is TV Tech/matics easy to use?* Extremely. Each volume is organized alphabetically -by-maker and then numerically-by-model number. Or you can use the comprehensive Chassis/Model Finder that is bound in every volume!

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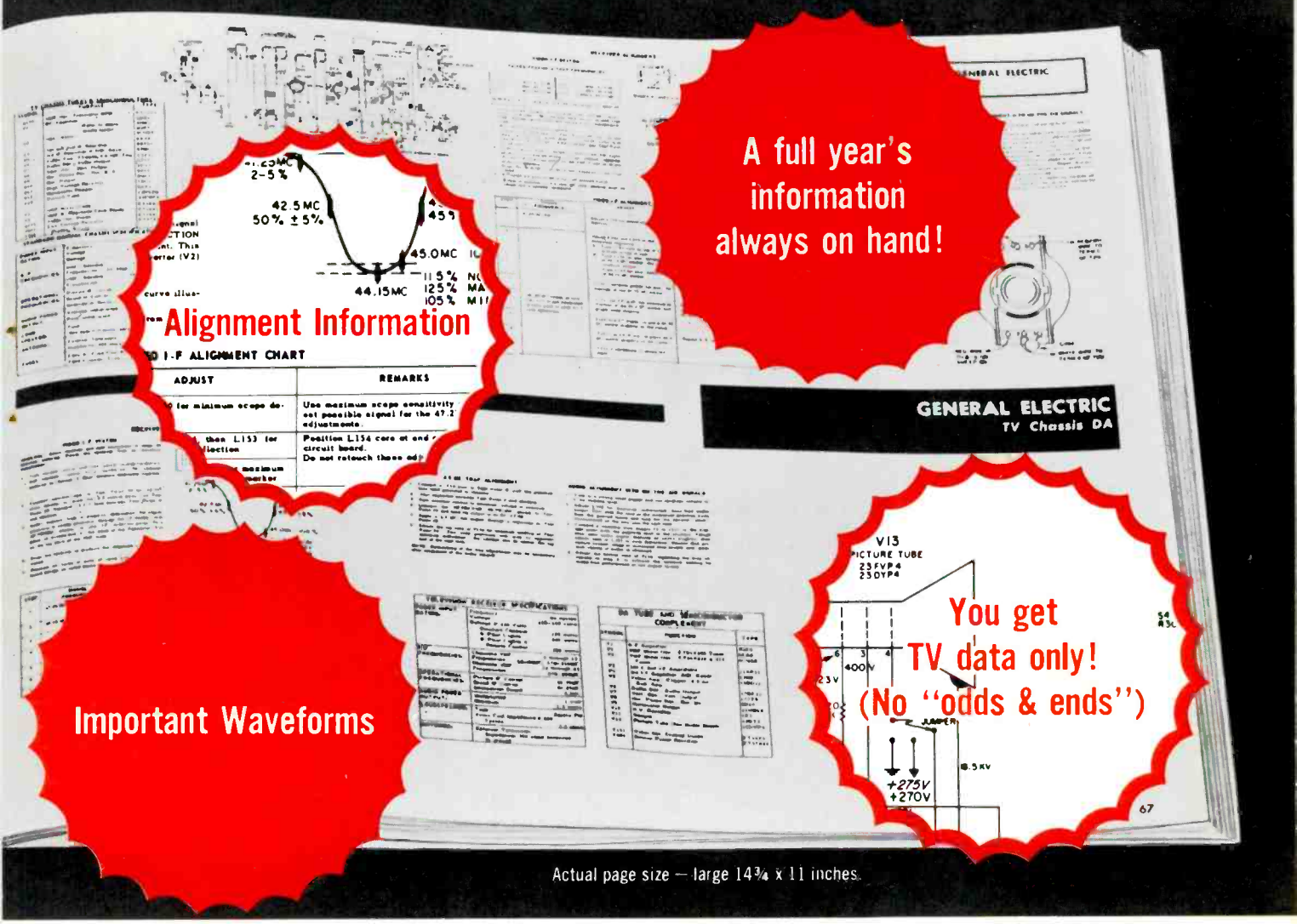

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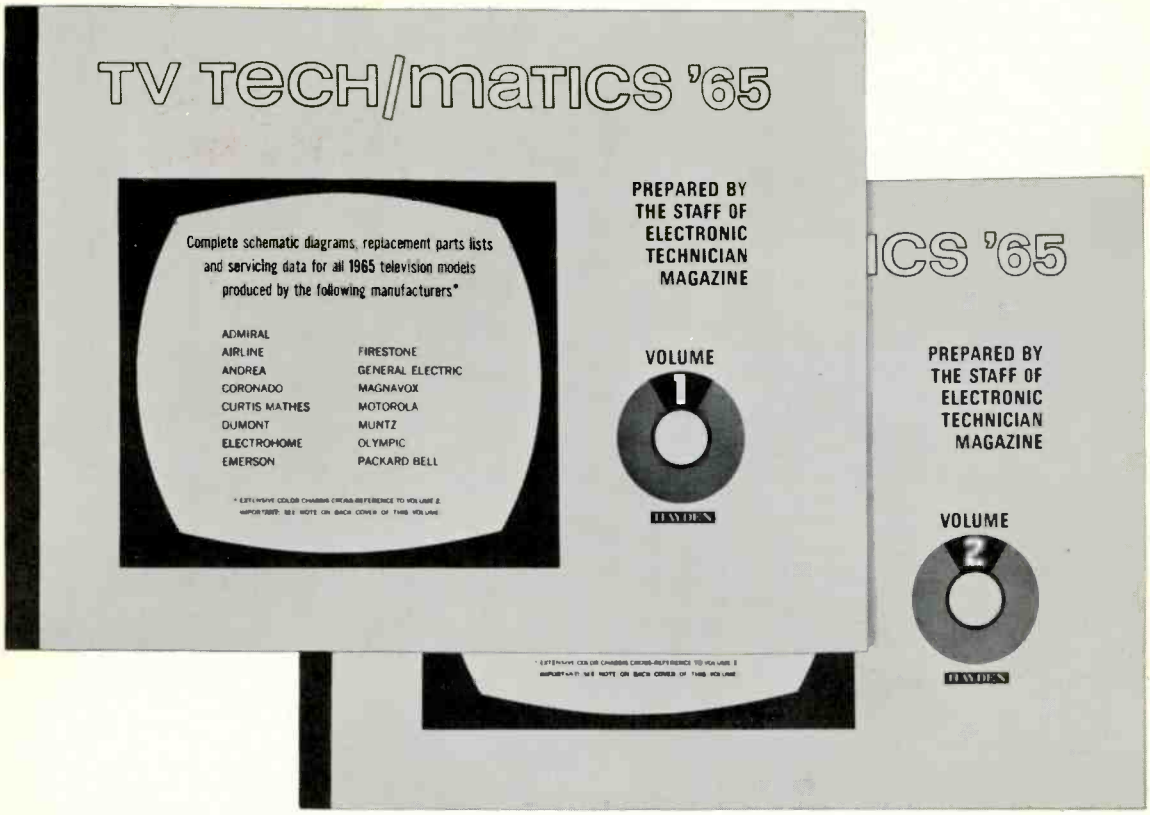

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note:

TV Tech/matics '65 — including all color sets since 1960 — is divided into two volumes for easier handling (see alphabetical list of makers). Because TV manufacturers may share an identical chassis in certain color sets, these are cross-indexed to avoid duplication. Sometimes this may require reference from one volume to the other. For this reason, we recommend the volumes be bought as a set.

Solid-State Portable Color Generator

■ A small, compact, light-weight solid-state color generator, battery operated and fully portable, is said to contain new circuit features (patent pending) that eliminate all hidden adjustments and permits full control from the front panel, according to the manufacturer.

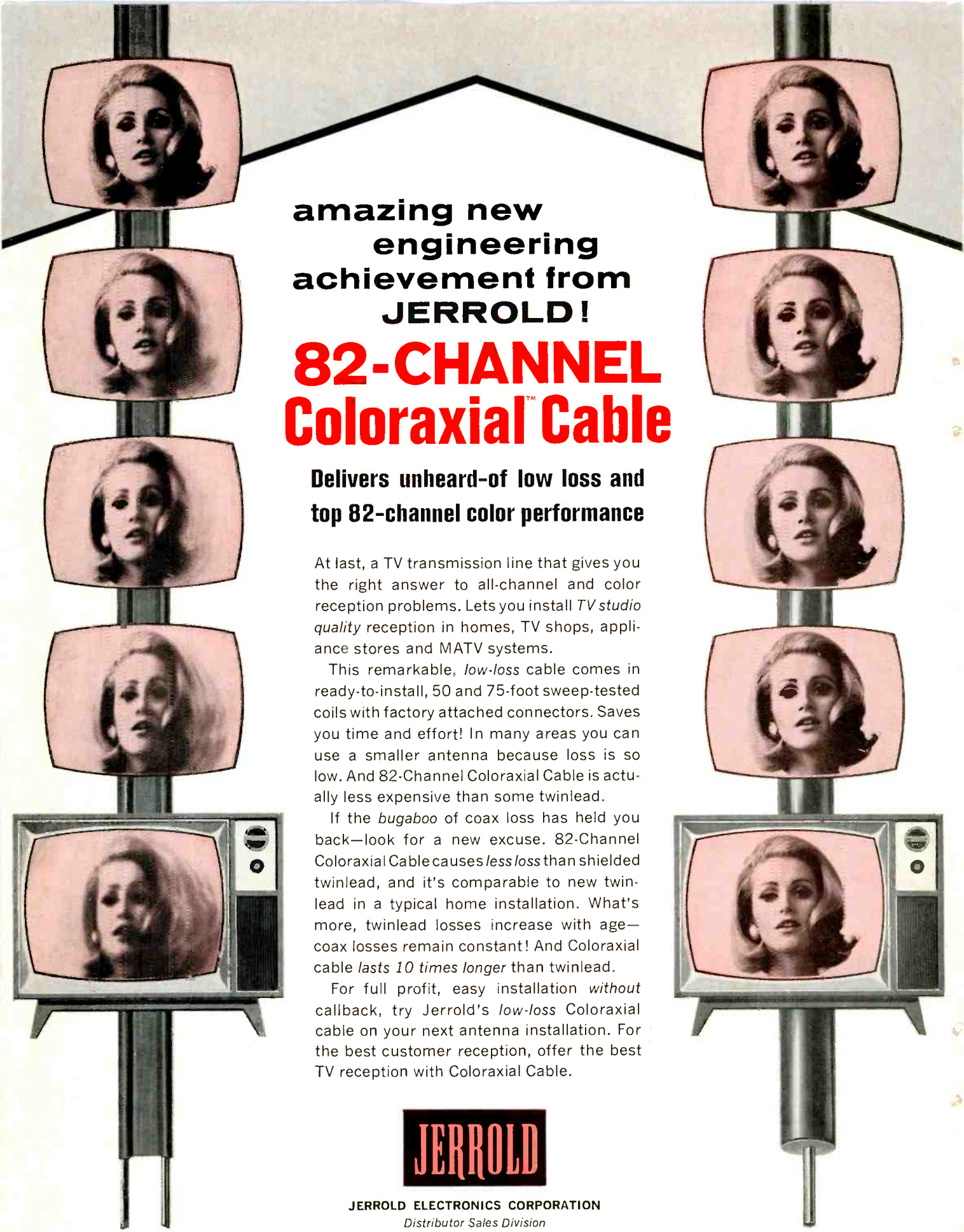
It proides various patterns, through any temperature range, and is said to require only a slight front panel adjustment at temperature extremes.

Manufactured by Sencore, the unit provides ten standard color bars, adjustable size white dots, cross-hatch pattern, vertical and horizontal bars and color gun interrupters.

RF output is set at the factory on channel 4 but can be easily changed to channel 2. The unit has one

189kHz crystal for timers and one 3563.795kHz for color bars. It has ten 2N2923s, two 2N404s, one 40234, one 2N1180, six 1N34As and one 8v zener diode. Power consumption is 20ma at 12v on color and 16ma at 12v on all other patterns.

The generator has four main controls on the front panel, plus the three timer controls. The main controls are the POWER switch, CHROMA control, FUNCTION switch and INTERLACE control. The RF adjustment, variable from channel 2 through 6; the dot size and the color phase are all accessible from the bottom of the unit. There are no internal adjustments. ■



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If the *bugaboo* of coax loss has held you back—look for a new excuse. 82-Channel Coloraxial Cable causes *less loss* than shielded twinlead, and it's comparable to new twinlead in a typical home installation. What's more, twinlead losses increase with age—coax losses remain constant! And Coloraxial cable *lasts 10 times longer* than twinlead.

For full profit, easy installation *without* callback, try Jerrold's *low-loss* Coloraxial cable on your next antenna installation. For the best customer reception, offer the best TV reception with Coloraxial Cable.

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ELECTRONIC TECHNICIAN

MAY 1966

Not many years ago a few "crystal-ballers" in the industry were predicting that home entertainment equipment circuitry would become more simple as time passed. Instead, it has got a lot more complicated. Along with this has come an increasing public demand for better and faster service.

The more discriminating music lovers become, the closer you have to check and adjust their equipment. All of these things taken together have automatically made it necessary for us to use better test instruments and troubleshooting techniques.

By injecting a squarewave signal into both channels of a stereo amplifier and by using a fast rise-time scope to evaluate the amplifier's response, an exact analysis can be obtained from the scope regarding any malfunction that exists.

These service techniques have been developed, tested and evaluated in actual service work. Read — and see — how it's done.

Rapid-Fire Location of Stereo Amplifier Faults

Learn how to be technically prepared for future developments in home entertainment equipment circuitry

■ "Ever wish you had a magic wand to point out the defective components in those pesky solid-state stereo amplifiers?" Bob Goodman, the Alexandria, La. technician, asked recently.

Bob calls himself an "electronics technician"—and he is. He does not consider himself a "TV mechanic" or a "serviceman"—which he isn't. And he doesn't call a TV set a "machine" either.

"I don't really use a magic wand," Bob continued, "but I can show you one of the fastest and most accurate methods yet devised to troubleshoot stereo amplifiers—tube or solid state."

Our ears perked way up.

"There's really nothing basically new about this technique. But I've developed it to a point where a defective stage—or even a defective component—can be very quickly isolated."

We were getting impatient for action but it came quicker than we thought.

"Here a very popular stereo amplifier, a G-E T7B chassis; we have had quite a few service problems and lot of experience on this unit. We've just finished troubleshooting and 'tacking' parts into it. It's no trouble to put the 'bugs' back in it."

How It's Done

Bob turned the chassis over, flicked a soldering gun deep in the set's innards, came up with a capacitor, picked up another capacitor from a box on the bench, flicked the gun again and said, "I'll feed a squarewave signal into both channels of this amplifier, connect the scope probes to the right and left channel outputs and see what we get. The generator is set at 500Hz.

"Note the top waveform (Fig. 1) which is the left channel output. The trace shows it has a loss of low frequency response. We 'hopped' the scope probe back and forth a few times in the left channel circuitry and practically tied down a defective 0.1 capacitor in the Q3 emitter circuit network (Fig. 2) a few minutes after starting on this job."

We were now all ears and eyes.

"Although we use a lab-type triggered dual-trace amplifier scope, much of this stereo work can be done with a good service scope and electronic switch—flip-flop. You may run into a little instability of the dual-trace and get a little interaction of the alternate traces with a flip-flop. And when it comes to locating a slight distortion in high quality component units used by critical listeners or other minute defects, the fast rise-time of a lab-quality scope will cut your service time way down," Bob continued.

"About 95 percent of these stereo amplifiers have something wrong with only one channel, with the other working properly. The beauty of this system is you can compare the good channel with the bad channel. In fact, you can even superimpose the two waveshapes for exact comparison and analysis. Even the slightest distortion in one channel can be detected. But let's take another look."

Bob went through the fast-draw, quick-fire gun routine again and then continued.

"The next problem arose when the right channel showed a peculiar type of distortion.

"Look," he said, "the top trace (Fig. 3). The scope probes are connected to the emitters of two audio amplifier transistors. We had a perfect squarewave at the bases of both transistors. One transistor was found to be defective. It had become resonant at this low frequency and caused the 'ringing' as shown in the top trace.

"When we first begin on an amplifier we make initial checks like total current drain, transistors overheating, overheating or burned resistors, cracked or broken circuit boards.

"The scope we use is calibrated in v/cm and the two channels are identical so it is very easy to check from one test point to another to compare the gain of each stage. This is very useful in checking the gain per stage throughout the complete system and for comparing each amplifier channel. But here's something else I'd like to show you," Bob said, and went through the gun-act for the third time.

"This problem developed in the preamp. With the scope probes on the two transistor emitters the waveforms show much less gain on the left channel (Fig. 4). The component that caused this trouble was a 0.003μf capacitor."

We were beginning to get the idea. This was signal injecting and tracing with a vengence. We started getting ideas about a big photo file with thousands of photos and a high-speed retrieval and comparer system. Bob suddenly interrupted our thoughts.

Another Case

"Let's look at another chassis, a Zenith 10MT25. The customer complained about one channel being noisy. After a preliminary check and nothing showed up—plus the problem of no service data since the set was brand new—we fired up the scope and generator and injected a squarewave into both channels. We began at the AF amplifier with the scope probes and moved on to the pre-driver. Then I noted at the collector of the right channel pre-driver what you now observe in the scope (see Fig. 5) at the top trace. See the 'hash' or 'grass' on the squarewave. At the transistor base we got a clean squarewave. That noisy transistor was tracked down in five minutes."

Bob Goodman ready to check stereo amplifier.

"Fantastic," we admitted.

"So you see," Bob resumed, "as a final check of the amplifier—or if the original symptoms show insufficient frequency response—the squarewave generator frequency can be adjusted throughout the entire audio range for a response check. We usually check them at 1kHz intervals and with both scope traces taken at the speakers you can readily see what frequency response the stereo amplifier will reproduce.

"Additionally, this setup is ideal for locating hum and buzz in these amplifiers. It has been my experience that hum in a solid-state amplifier can give service technicians a tough time. In making these checks for hum and buzz, pay close attention to bypass capacitors,

continued on page 106

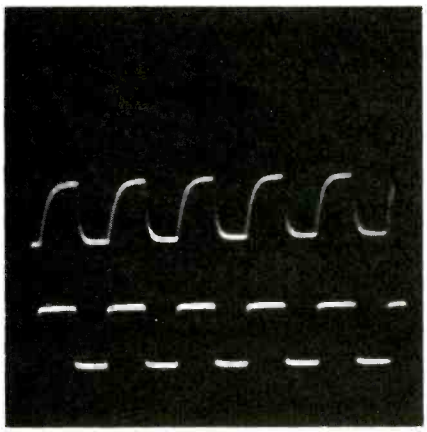


Fig. 1—Top traces show loss of low frequency response.

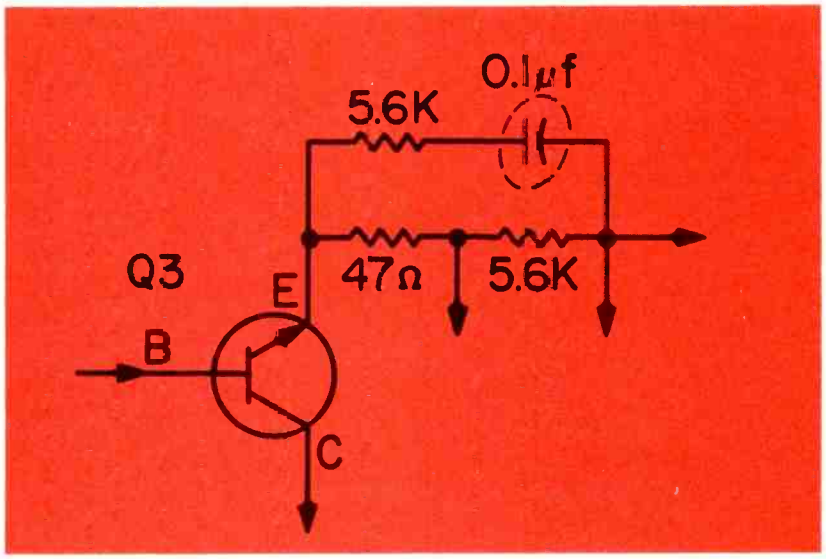


Fig. 2—Schematic showing location of defective 0.1μf capacitor.

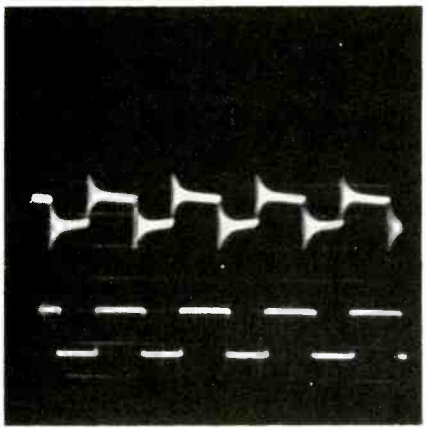


Fig. 3—Defective transistor caused distorted squarewave signal shown at top.

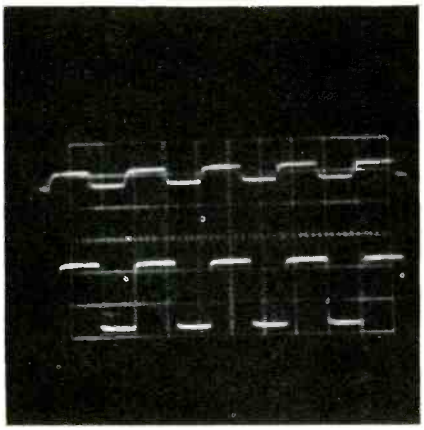


Fig. 4—A 0.003μf capacitor showed loss of gain in one channel as shown on top trace.

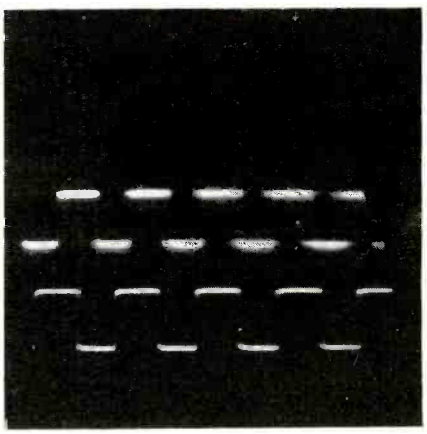


Fig. 5—A noisy transistor caused the 'hash' on top trace.

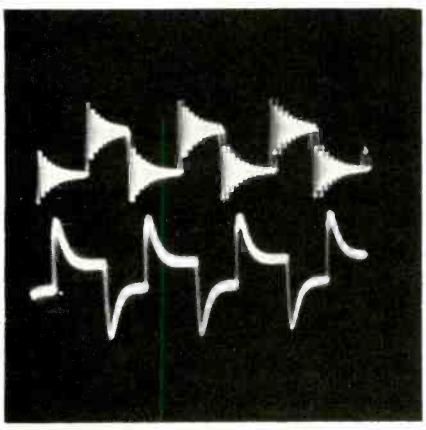


Fig. 6—Both traces shows effect of tone control adjustment of both channels. Top trace shows one channel control set for base and bottom trace shows the other channel control set in the treble position. Arrangement gives brilliant tonal response.

How square waves look after passing through both channels of stereo amplifier.

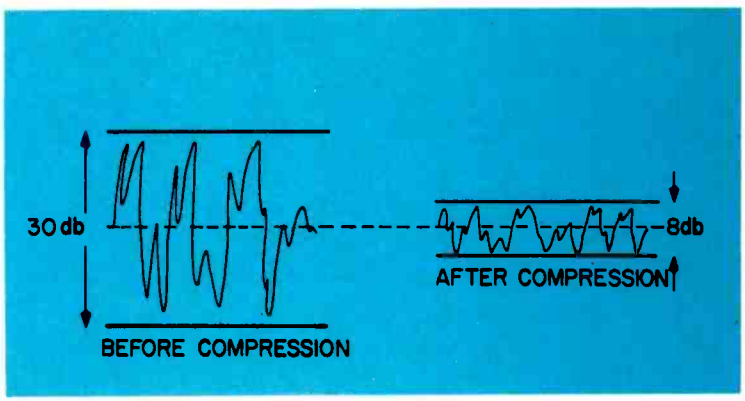


Fig. 1—Compressor input and output levels.

Volume Limiting

Understand how PA and background music

■ The human ear can clearly hear the soft rustle of leaves on a quiet summer night, and it can also hear the tremendous roar of a jet engine close by. Human hearing, then, can accommodate a wide dynamic range of sound volume—roughly 120db, which is a ratio of a trillion to one. And it does this without overload or distortion.

Unfortunately, electronic circuits have their limitations. The upper range of high-fidelity circuits is about 60db, a ratio of a million to one. Communications circuits have the lowest range, approximately 20db, or a ratio of 100 to 1. Many so-called "Hi Fi" amplifiers are somewhere in between 60 and 20db.

It is very easy to overload an amplifier, and when this happens, distortion is the inevitable result. That is why the volume control was devised. Setting the volume by hand does fairly well as an approximation —it will prevent the worst type of overload. But three difficulties arise: (1) The volume control must be set to allow the loudest sounds to be amplified without distortion, and this means turning the volume way down if there are very loud sounds; (2) when the volume has been turned down, low passages may not be heard; (3) if the control is set in between to amplify both low and loud passages, human reaction isn't fast enough to turn down the volume when fast, high-level peaks appear.

What is needed then is an automatic circuit to reduce the gain when a high-level peak appears, but allow low passages to be reproduced with full volume. This reduces the dynamic range of the original sounds, but this is necessary because loud passages would be distorted, while low passages would be lost in the circuit noise.

Equipment Requirements

Previous articles here have described volume-limiting components in two-way communications work. In that field, speech is the only desired program material; hence wide frequency response and low distortion are of no particular importance. Where esthetic values prevail, however, as in public-address and background-music systems, volume limiting components must have wide range and low distortion.

Constant level is desirable in PA equipment to minimize acoustical feedback, maximize understandability and compensate for differences between various human speakers. Similarly, background-music systems aim to present a "curtain" of sound which will unobtrusively surround listeners without intruding upon conversation—and this means the music level must always be at the same amplitude. Since wide frequency range and freedom from distortion is essential in these systems, compression must not impair response.

The Compressor, or AGC Amplifier

A compressor is essentially an averaging component. It accepts input variations on the order of 30db and supplies output signals within an 8db range (see Fig. 1). To accomplish this, one stage of the circuit has variable gain. This gain is controlled by the amplifier output. The result is a sloped input/output curve, as shown in Fig. 2. Note that normal, or average signal level, is in the *middle* of the compression slope; this means that signals below this point are amplified more, and those above, less. This is precisely how volume compression works.

Compressor attack time—time required to reduce gain following an input peak—averages about 24msec, which permits some sharp signals to get through, but holds level steady for over-all program material. Release time—time for gain to return to normal following a peak—is usually much longer (a full second or more). But this depends on the type of program material. Both attack and release times are often variable. For voice, popular and jazz music, the short fast-acting release is preferred, with gain returning rapidly to normal following a peak. But for classical or religious music, a dual-recovery circuit is often used. This offers fast recovery from a sudden, sharp

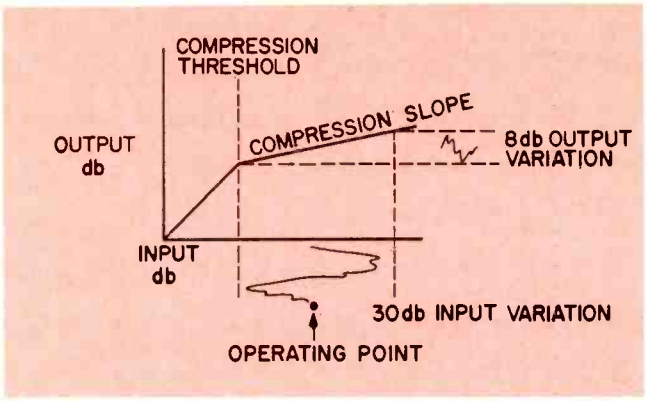


Fig. 2—Resultant sloped input/output curve.

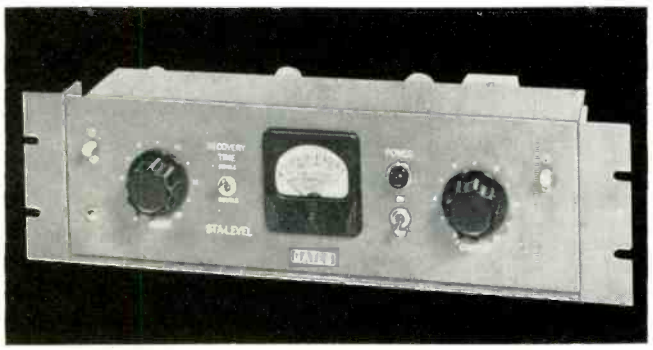
In Audio Systems

compressors work

peak, and slow return from a sustained peak, which sounds more natural.

Some Typical Compressors

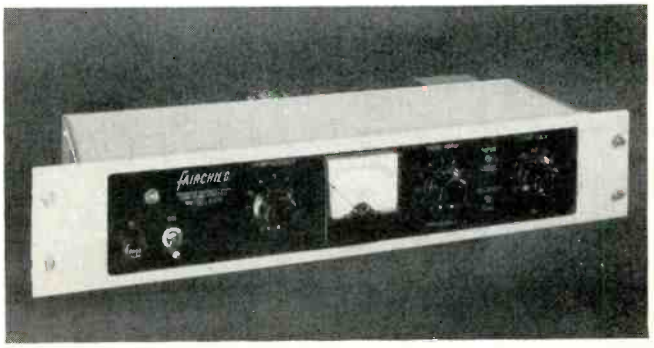
A typical compressor has more-or-less standard circuitry (see Fig. 3). Its two stages are operated push-pull to avoid distortion caused by rapidly varying grid bias on the variable-gain amplifier and to avoid thump caused by shifts in supply voltage. Signal at the input is set by R1 to the operating point of V1, the variable-gain controlled stage. V2 runs with fixed gain and drives the output. A portion of this output passes through C2/C3 to the cathodes of V3. R4 sets the threshold, or point below which the diode won't conduct, by applying positive bias to the cathode through bridge R5/R6. When signal at the amplifier output exceeds this bias, V3 conducts, placing negative dc on the control line. This line feeds bias to the grids of V1 and thereby controls its gain. C1 and R3 form the release-time network (attack is fixed) and R3 varies the duration between 0.3 and 1.3 seconds. The meter across R2, in the cathode circuit of V1, indicates current through the stage — reading the degree of compression.



Gates M5167 compressor.

Collins 26J1 compressor.

Altec-Lansing 438C Compressor.



Model 666 compressor by Fairchild.

Volume Limiting . . .

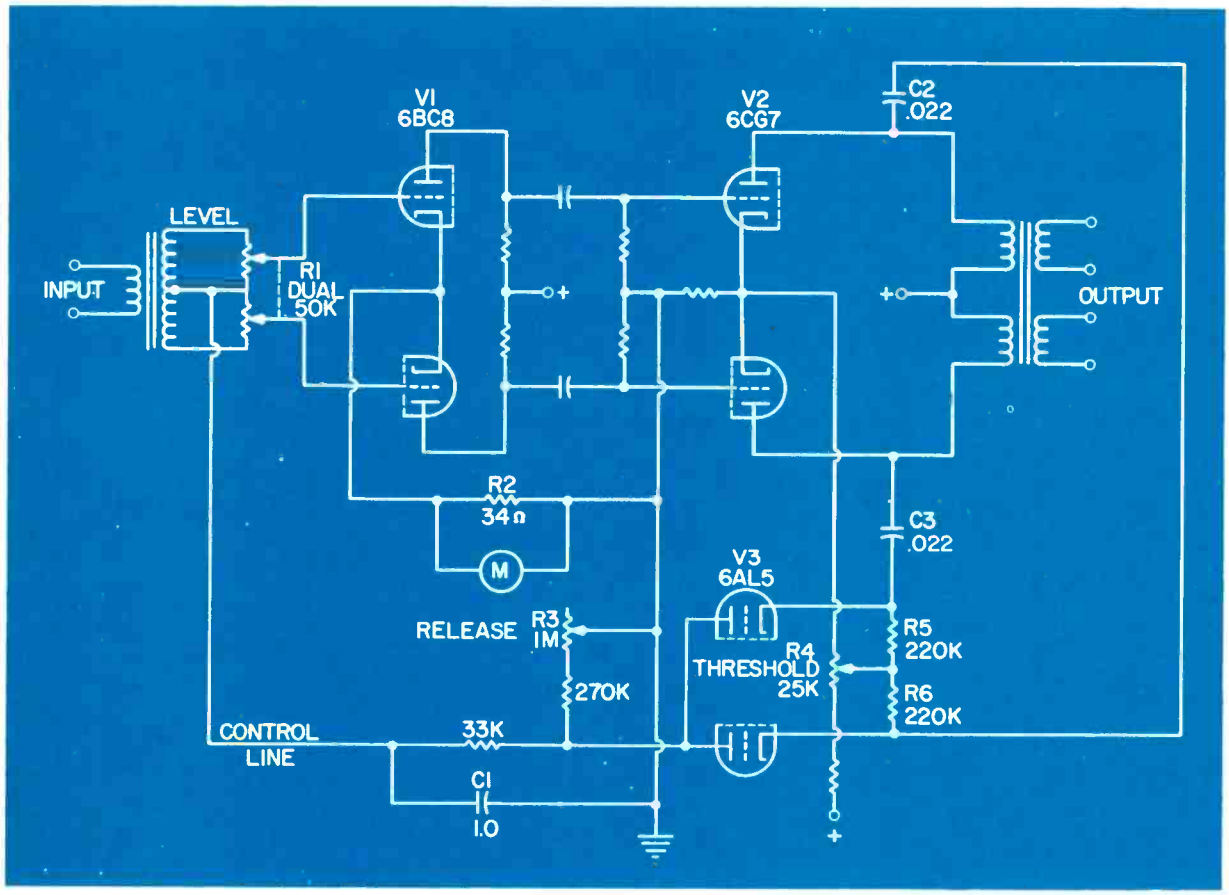


Fig. 3—Schematic of typical compressor.

Another unit consists of the basic circuit, using a 6386 tube in the controlled stage and push-pull 6V6's as output. Dual/average time-constant switches are provided, as well as threshold controls. The unit is self-contained with a panel meter, input and output attenuators, a defeat switch to disable the compressor action and 600Ω impedance in and out.

Some compressors employ the losser circuit, a different approach to level control. Varying bias to a controlled stage always introduces distortion and thump, no matter how small. However, a variable resistance placed in shunt across the signal, as from gride to ground, alters signal level but does not change operating characteristics of the stage. Hence, no distortion. Rather than a conventional resistance, an electronic resistance is used—a diode. Amplifier output voltage is rectified and the resulting dc applied to the losser diode. With increasing output signal, dc increases through the diode. With increasing dc through it, the diode's impedance *decreases*. Since it's across the signal, it attenuates the signal. But the amplifier stages following are running fixed-gain, hence distortion is not caused by compression.

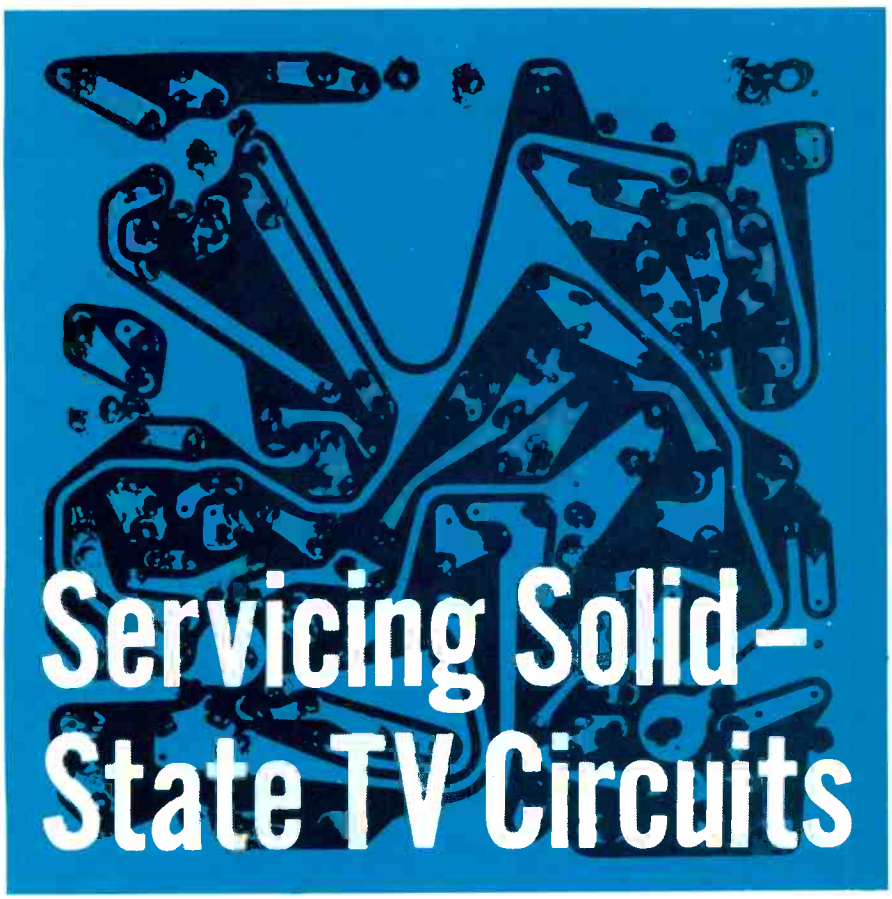
In addition to flat compression, an equalized mode is available which provides increased gain reduction in the 3- to 4kHz range. The usual controls are located on the front panel.

One version is completely transistorized and small enough to be panel-mounted. Its input and output will handle 150 to 50KΩ. The unit has no power supply and requires 6vac or 9vdc at 150ma. This type unit makes it possible for each input on a console to have its own compressor.

Another unit has a standard circuit but uses a 12AT7 fixed gain-buffer stage between the 6386 input and push-pull 6V6 output. Also, a VR tube is strapped across the power supply to minimize stability problems in the controlled stage. Input and output attenuators are furnished and there's a front-panel switch, marked *single/double,* for changing attack and release times. A resistor kit is also supplied to further alter release time. Input and output attenuators are on the front panel and impedances are 600Ω.

A forthcoming article will describe a number of other compressor types—some with elaborate and unusual circuitry. ■

Know your transistorized power supplies, tuners, IFs and video amplifiers



Servicing Solid-State TV Circuits

■ Only two or three years ago some people in the TV-radio service industry were predicting that transistor TV imports would ruin the service business. But the TV business is bigger today than ever and most TV manufactures have one or more transistorized TVs in their line. At least two major companies have hybrid color receivers. Certainly the new lines, which will be shown this spring, will give us another increase in the number of solid-state TV components used.

Most information on solid-state TV reveals that few functional differences exist between electron tube and transistor circuitry. But vast differences exist in the area of servicing techniques.

Two Minute Review

We promised in this series to continue hammering away at transistor fundamentals — briefly sandwiched in between practical circuit functions and servicing procedures. It is assumed that the reader has a fundamental knowledge of transistor physics. Let's again remind ourselves of a few fundamentals:

1. The transistor amplifier always has a forward bias on the emitter junction under no signal conditions.

2. The collector junction is always reverse biased.

3. In a PNP transistor, the base and collector are always *negative* with respect to the emitter.

4. In an NPN transistor the base and collector are always *positive* with respect to the emitter. We remember this fact simply by the middle letters of each type — the "N" of PNP and the "P" of NPN.

5. All transistors now in common use are either germanium or silicon.

6. Emitter junction voltage for germanium transistors is usually 0.2 to 0.4v.

7. Emitter junction voltage for silicon types is usually 0.6 to 0.8v.

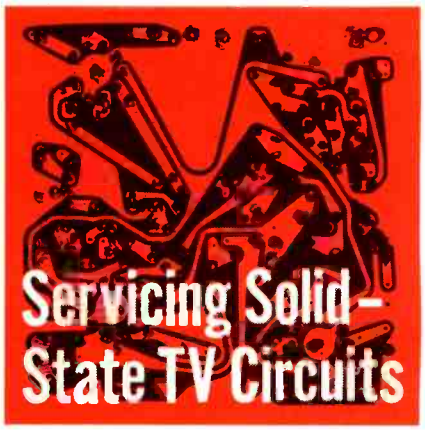
8. The collector-to-emitter potential varies from less than 6v to more than 100v in most TVs.

The similarity of a transistor TV and electron tube TV is easy to see if one investigates the block diagram for each set. (See block diagram of Solid-State TV in Fig. 1.) Since both TV types have the same function, they necessarily have the same circuit functions. That, however, is about the limit of the similarity.

The three types of circuits commonly used in electron tube sets also have their counterparts in solid-state. The common amplifier found in electron tube circuits (common cathode) has an equivalent (the common emitter) which is also used most frequently. Also, the emitter-follower is used more frequently in solid-state circuitry than its counterpart (the cathode-follower) because the isolation this circuit provides from driving stage is not found in other transistor configurations.

Only the tuner frequently employs the grounded base (equivalent to the grounded grid).

Unlike tubes, transistors have extremely sharp-cutoff characteristics. In fact, the region of cutoff is so small it is quite common to



use forward bias. When forward bias is used, the transistor's gain is reduced by biasing it more toward saturation.

Power Supplies

The power supply will probably be the most familiar ground for those technicians newly initiated to transistorized TV circuitry. Solid-state parts are not new here. Probably the most strikingly different thing about these power supplies is that you can work on them without fear of electrocution. (Generally speaking, of course, anything connected to the line should be considered hazardous.)

The type of power supply will vary according to mode of set operation: whether the set was designed to be operated from the lines only or from a battery as well. If the set is to be operated only from the line it may or may not have a line transformer. The voltages developed will generally be higher on the line operated TV and several rectifiers may be used to develop different voltages necessary for various sections of the TV.

TVs designed to be operated from the line or from an external battery source are generally powered from a bridge rectifier driven by a 12v transformer for line operation. These same sets receive their power directly from the battery to the 12v buss for battery operation. It is not uncommon to see two circuit breakers or two fuses on the lines on these sets since one fuse is needed for ac and another is needed for dc. An ac/dc power supply schematic is shown in Fig. 2.

The Tuner

Transistorized UHF tuners have been used longer than solid state VHF tuners but their exceptional reliability has caused many technicians to go about their work unaware that solid state UHF tuners are being used in such a large number of TVs. The most common failure in these units is the mixer diode. Fortunately, the mixer diode is readily accessible and is often a clip-in component.

The UHF tuner is most often a one transistor and one diode device. Its output is the IF frequency. The output of the UHF tuner is not fed directly to the IF strip, but, like tube tuners, to the VHF tuner. When the channel selector is tuned to the UHF function the VHF oscillator is disabled and the RF section of the VHF tuner becomes a UHF amplifier which feeds the IF strip.

AGC is employed to control the RF amplifier gain. Because the VHF RF amplifier is used in both VHF and UHF functions, an effective gain control is maintained for both VHF and UHF tuner modes. The schematic of a solid-state UHF tuner is shown in Fig. 3.

The IF

Three transistors are usually employed in solid-state TV IFs. The actual configuration of the IF circuitry may vary widely, however. For example, it is common to have transformer coupling or capacitor coupling. If capacitor coupling is employed, a coil is used as the lead in the collector circuit. Transistor IF coils are generally small and have a low inductance and high Q.

Small capacitors (2.7pf and up) also clutter the typical IF strip. These are neutralizing capacitors to help stabilize the amplifiers. Actually, they equalize the transistors' internal capacity. Other stabilization is sometimes used in the form of degeneration, etc., depending on the transistor types and consistency of their parameters.

Alignment will be less of a problem with most transistor TVs since the bandpass is generally broader. In many cases the collector loads and transformer couplings are not adjustable. The proper response and IF characteristics are primarily maintained by the traps common to tube or solid state sets.

The IF detector, like the power supply, has been solid-state for many years. There are few changes in the solid-state TV version in the detector area. Either series or shunt detector systems are used in existing TVs, though the series detector is most common.

In many cases, the ideal dc coupling was difficult to obtain in tube sets. With transistors, however, the video is often dc coupled from the detector to the CRT because the transistor lends itself to dc coupling more easily than tubes.

Video Amplifiers

Perhaps, too often, the video amplifier section is thought of only as a video amplifier. And although its name implies just that, a closer examination shows that it serves several other functions. Aside from its principle function of amplifying the detected video signal enough to drive the CRT, it contains contrast and brightness circuitry, puts out a signal for AGC and sync development, inserts blanking in some cases and provides the sound section with the proper signal.

Early transistor sets used up to three stages of video amplification but current sets generally have two and sometimes even one. The video amplifier has quite a task since it must amplify video from only a few hertz to several mega-hertz with good linearity. It's easy to see why some manufacturers are a little uneasy concerning substitution transistors. Transistors with the ability to reproduce better than 100 MHz are frequently used in TV IFs and state-of-the-art design rarely enters into performance. Although quality replacement transistors are readily available, haphazard replacement may cause more headaches than any natural malfunction. The transistor's high frequency cutoff must be considerably

higher than the IF frequency in most set designs.

AGC control voltage is always taken off after demodulation. The level of the voltage at the detector output is low, however, so the AGC voltage is often taken from the output of the first video amplifier. Since the detector and the first video amplifier are dc coupled, the dc AGC voltage as well as the video signals are amplified.

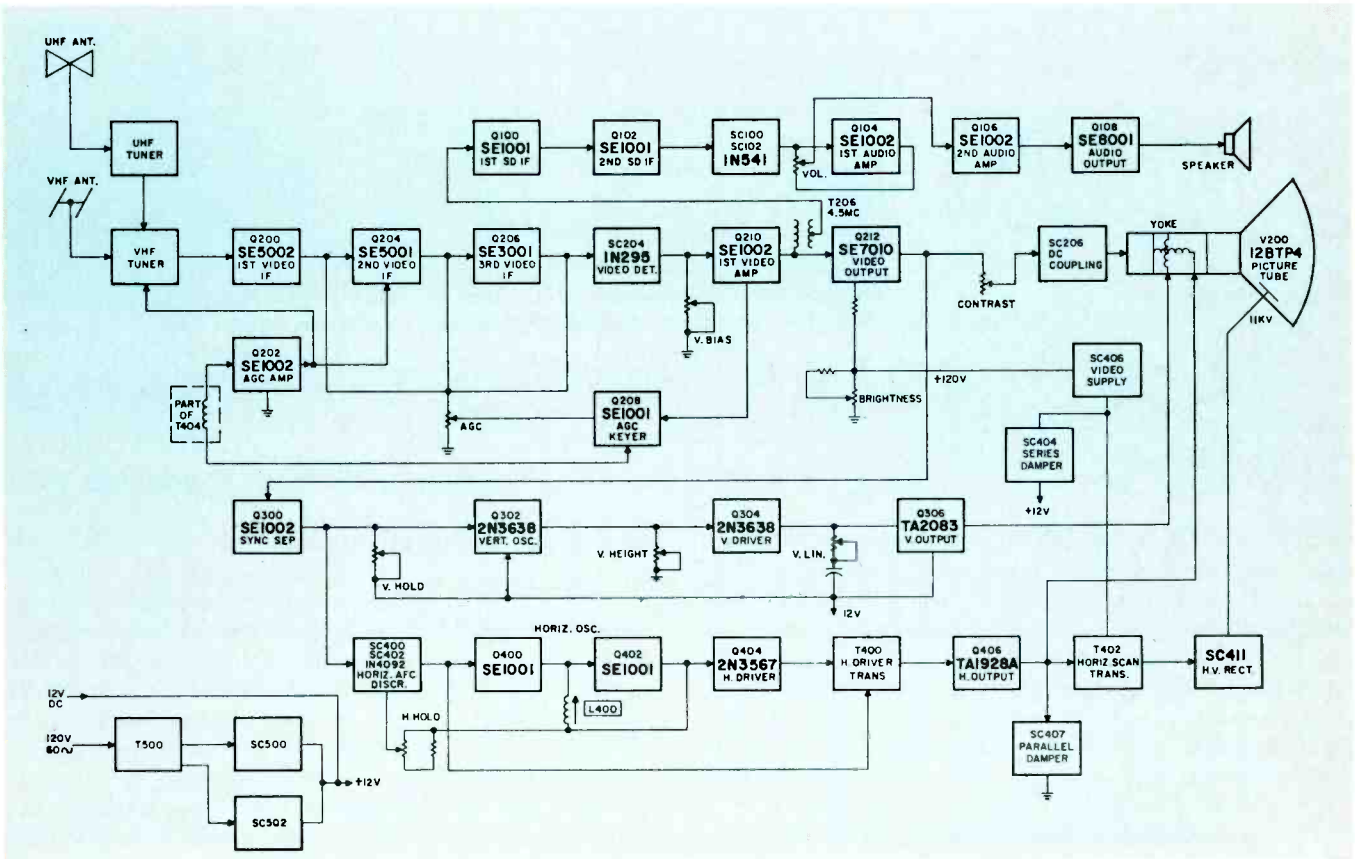
The circuit configuration for a given video amplifier depends on several factors. Two of the most important determining factors are (1) the polarity of the detector and (2) whether the picture tube is driven at the grid or cathode.

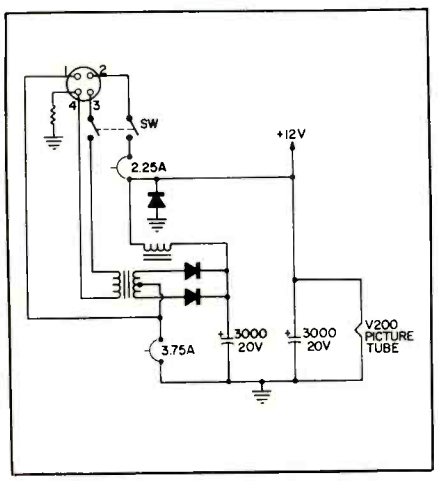
Although tubes have more linear response over a wider frequency range than transistors, the peaking coils employed in tube video amplifiers are sometimes not found in solid-state video amplifiers because a transistor's impedance changes considerably with frequency.

Contrast control is also achieved in the same manner as in tube circuitry. The video amplifier's gain is changed to effect the contrast change — the usual method is with a potentiometer in the video amplifier emitter.

Brightness too, is achieved by conventional methods. The principle is to change the CRT bias so the beam intensity is changed. This is accomplished with a control and bias network between the control grid and CRT cathode.

In the next article of this series we will dig into solid-state AGC, sync, noise rejection, sweep and audio circuits. ■





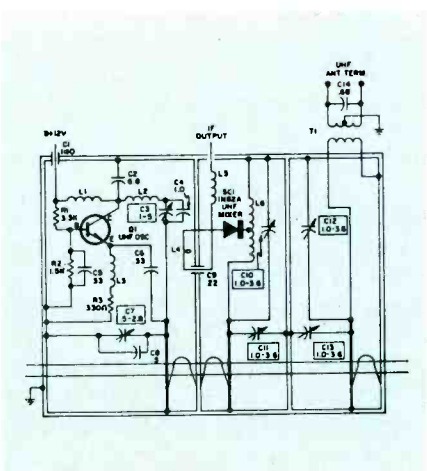


Fig. 1—Block diagram of Sylvania solid-state TV receiver.

Fig. 2—Typical solid-state ac/dc power supply.

Fig. 3—Solid-state UHF tuner schematic.

Stanley's is located in an old neighborhood but has a modern and attractive front.

Cash Register Plays

Stanley's of San Francisco is a

■ Sales — office procedures — service shop. Are they pulling in harness?

If so, the cash register plays Jingle Bells, says Stanley Michelsen.

Still years from retirement age, Mr. Michelsen is the dean of San Francisco's sales and service men. Back in 1922, he was winding coils on oatmeal boxes and peddling crystal sets to other kids in his San Francisco neighborhood. He's been in some phase of TV-radio sales and service ever since.

Stanley's Radio TV Service, located in the city's old Mission district, advertises "8 experts to serve you. Famous for service for over 20 years."

Experts include Mrs. Michelsen, no mean hand herself at radio repairs. But her major forte is Stanley's customer tracking and bookkeeping system, giving this relatively small shop top control over the entire operation.

Mr. Michelsen ticks off five basic requirements for a profitable service operation: 1) An intelligent customer relations policy; 2) Skilled service technicians; 3) Adequate supervision; 4) All the best tools and service instruments; 5) Conveniently arranged shop.

"We're not too large," Stanley Michelsen says, to give customers personal attention, and not too small that we can't handle everything in service. We think we have the best-run shop in this area — and so do many of our customers.

Customer Relations

Stanley's carries out an active customer relations program to build sales and service. Volume last year was $290,000 — 70 percent sales, 30 percent service.

"Our first rule when it comes to selling is always to give customers something to remember us by," Mr. Michelsen says. "We never let anyone leave the sales floor empty handed."

Mr. and Mrs. Michelsen and store manager Ben Lynch handle the front of the house. Whenever the shopper shows even a mild interest, he is handed a red, white and blue advertising pen before leaving. He's told: "Here's our calling card. Come in and see us again when you're ready to buy." That's the kind of calling card people don't throw away, in this shop's experience.

Even if the shopper shows less than mild interest, he is not permitted to walk out empty handed, but is given a manufacturer's brochure or two to take with him as a reminder to shop Stanley's when he's ready to make his purchase.

When a sale is made, the customer is handed a quality ballpoint pen to sign the contract. The pen is given to him as a memento of the transaction. If the sale is made to a husband and wife together, the wife receives a dainty round pen and the husband a square masculine-looking pen.

About a week after a set is installed, a return ad-

Sales floor is well organized and shows a good selection of TVs, radios and phonos.

Stanley Michelsen follows up a prospective customer by phone.

Mr. Michelson checks out a difficult job with one of his shop technicians.

'Jingle Bells' Year Round

modern, well-managed service-dealer operation

dress postcard is mailed to the customer, asking if the set is working satisfactorily. The same policy is followed after every service call.

"In almost every instance, if the customer has a beef, we'll get the card back," Mr. Michelsen says, "and that gives us the opportunity to take care of it. But if it's just a minor beef the card may not be returned — and that means there's a small hole in our customer relations.

"Therefore, whether it's a sale or a service call, if we don't get the card back within about a week, we telephone the customer so that we can pick up on even the minor complaints."

As part of Stanley's customer relations program, Mrs. Michelsen organizes a customer followup system around a color-coded card file set up on a Rollidex, a large revolving wheel holding card for all sales and service customers for four years back. Every customer transaction is entered on his card for a complete record.

Cards on the wheel are color coded according to type of account: Green, "buy and service;" white, "service only;" yellow, "buy without service;" blue, "top customers;" red, "COD only." All cards are filed alphabetically on the wheel, with the color coding giving instant indentification of the customer's classification on the basis of his importance to the firm.

"The blue cards, our top customers, can walk off with the store," Mrs. Michelsen smiles. "And there's no having to scan through a customer's account to find out what his payment record is — the red card signals it's cash in advance.

"But, more importantly, color coding by customer classification and setting up the cards on the Rollidex enables us to follow up, easily and readily, customers we haven't heard from for a while."

Each day, after the other essential office work is done, as many Rollidex cards as possible are checked over. If, for example, Stanley's hasn't heard from a white-card customer (service only) in a year, a telephone call will be made along the following line: "Since we haven't heard from you in a year, we assume your set is working all right, but we just wanted to make sure." This personal contact brings results, keeps Stanley's in touch with their customers.

Handling Phone Calls

How telephone calls are handled is another important part of Stanley's customer relations program. The firm has five lines coming in so that customers seldom get a busy signal.

A large book for recording phone calls, six duplicate message forms per page, is kept by each telephone. All phone calls that come in must be recorded in these books.

The only person who can remove the original form from a book is the one who answered the phone and

wrote down the information. After he has taken whatever action is required, he makes a check mark on the form and tears off and throws away the original. The duplicate pages are reviewed daily to make sure that every form has its check mark indicating it has been handled.

"Failure to follow through on phone calls is the bane of the service business," Mrs. Michelsen declares. "We use this rigid checkup system to guarantee the best in service."

Advertising

"Recommendations from our customers are a source of considerable business for us. Within the last few weeks, for example, we've sold a couple of color sets to friends of customers. Our customers didn't just recommend us, but brought their friends right into the store to look at sets," Mr. Michelson says.

Mr. Michelsen doesn't depend on recommendations and word of mouth advertising, however. Some newspaper advertising is used to reach new customers and he admits he probably should use more. He prefers the newspaper's TV log pages and doesn't price-promote extensively, but places the advertising emphasis on service and years of experience in the business. Some direct mail promotion of color sets goes out to B/W customers.

Recently, a stereo room was built on one side at the front of the sales floor, and direct mail is going out to old B/W customers and steady service customers, inviting them to come in and see the special stereophonic room.

Stanley's gets the big look on the sales floor as the most effective means of point-of-sale advertising.

"You can't sell from an empty wagon," Mr. Michelson says. "On the other hand, it's our experience that it's not good to show too many brands. We stay with the top three in TV and go across the board in brown goods with radios, phonographs, tape recorders and blank tapes."

The display floor is set up to show the lower, middle and upper in each brand and in the most popular style cabinets. More and more people are going for decor in cabinets, Mr. Michelsen notes.

"We've found to our sorrow, however, that we can't always finalize the decor from the manufacturer's brochure," he smiles. "The color isn't always reproduced accurately in the brochure and besides there are variations in color, wood and graining from set to set.

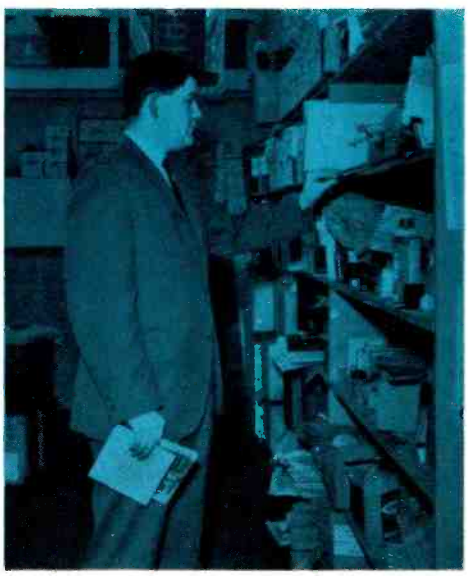
"If you get a special color for the shopper and then it's rejected, it's hard to sell the set to someone else. Therefore, we've found the best arrangement is to take the shopper interested in the unusual style or color to the distributor's display floor."

Service Policies

The service area, now being remodeled, is walled off from the sales floor, but has a large service counter set in the separating wall at the rear of the sales area. Standing at this counter, the customer can see into the shop.

"The shop has to be closed off so the work can get done in peace," Mr. Michelsen declares. "But customers must be able to see the men at work. A shop that's open to the customer's view is the way to give an image of responsibility. It just can't be done with signs on the sales floor, although we use a very large one to publicize our shop."

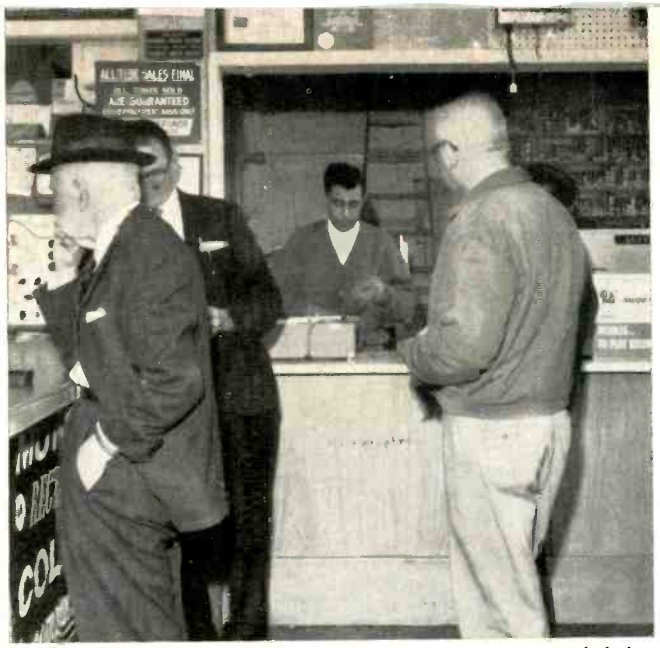
Mrs. Michelsen at the Rollidex.



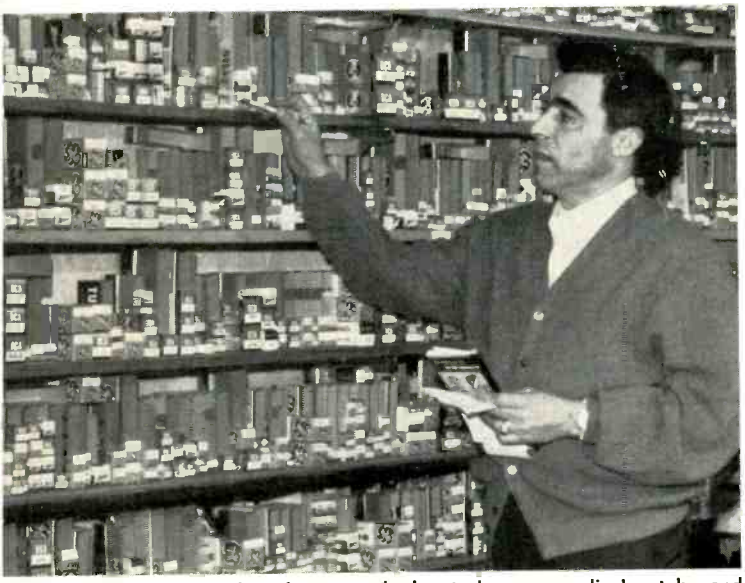
Ben Lynch selects brochures to give to a customer.

Stanley's employs six service technicians — two on outside service calls, three in the shop, and an apprentice. Minimum service charges are $2 on radios, $4.50 on TV sets brought into shop; $7.50 on B/W and $9.50 on color service calls.

The shop pays top union wages ($4.05 per hour) and gives all employees a California Physicians Service policy covering the whole family and paying $70 per week if the employee is disabled or ill. This extra fringe benefit costs the firm $30 per month per man but the service technicians like the feature and tend to stay with the shop. The shop foreman has been with Stanley's for 19 years, another man 15 years, another nine.



Service shop has its own counter. Customers can see the work being done even though the shop area is closed off from the sales floor.



Mike Pusaro, shop foreman, checks stock on open-display tube and parts shelves.

Stanley's has a small incentive plan for outside technicians. Whenever an outside man encounters a call where the set is very old and needs a major overhaul, the technician will advise the customer to look at a new set. If the customer agrees, he will either take the customer in then and there or Mr. Michelsen will go out as soon as can be arranged and pick up the customer in his station wagon. The technician receives a bonus if the sale is made.

" 'Strike while the iron is hot' is the motto behind this approach," Mr. Michelsen says. "On the other hand, it's a modest bonus the technician gets. I don't think service technicians should try to be salesmen, and so we pay enough to serve as an incentive, but not enough to encourage them to use high pressure tactics on their calls."

Shop Supervision

Adequate supervision is developed by not tying the shop foreman down with too much bench work, although it is necessary for him to carry some load in a relatively small shop.

There must be an expert and identifiable person to take care of customers at the service counter, Mr. Michelsen maintains, not only to handle and discuss the service and charges, but also to establish customer relationships. The foreman, therefore, waits on all customers coming in for service when Mr. Michelsen is tied up in sales or other work.

"Work efficiency depends completely on management practices," Mr. Michelsen says. "It's essential that the shop foreman, as well as the owner or manager, know the capabilities of each man in the shop so work can be correctly routed.

"Certain men don't like to work on certain sets. While we try to overcome this kind of prejudice, it's there and we have to live with it. It's human nature that the more you know about a set, the more you like it. In a small shop, everyone can't be a specialist but insofar as possible we route the work for the man's capabilities. Otherwise, efficiency falls to pieces at the bench."

Efficient shop management depends also on checking the work orders, watching out that the free calls are not being abused, and knowing when to reject a job. Stanley's finds a lot of oddball stuff is coming into the country now, at least in San Francisco, a port city. If they can't get the parts and a "road map" on the set, the firm refuses to handle it, frankly telling the person who brings it in, "Next time, you'll do better to buy a brand name. You'll save money in the long run."

Paying top wages Mr. Michelsen expects production per man in the shop and field to run $62 to $72 per day. The shop is set up with all the latest tools and test instruments and is efficiently arranged to save steps. The wall behind the benches is covered with pegboard holding all the hand tools and light test equipment needed for that bench. Work areas are strongly lighted with swivel lights that can be adjusted to the service technician's convenience.

An open-display small parts and tubes wall runs full length across the shop, providing ready access to the faster moving parts so that technicians can find what is wanted without hunting.

Another timesaver is using castered dollies to hold all the sets coming into the shop. Every set coming in goes to its own dolly and nothing goes on the floor — it's always portable, from the time it arrives until ready for delivery, can be moved around, pushed out of the way, and brought up to the bench.

Mr. Michelsen developed a color test tube jig about six years ago — several months before one was put on the market. This, he says, is perhaps the single most important piece of equipment in the shop ". . . but many shops still don't have one," he adds.

"We're in a real chicken and egg business," Mr. Michelsen concludes. "We have to produce sales for service and service for sales, and who knows which comes first? But hook them both into an efficient over-all system, which I believe is lacking in most small shops, and you are in a good profit position." ■

YOU and Your Oscilloscope

Know how your scope works and it will work for you

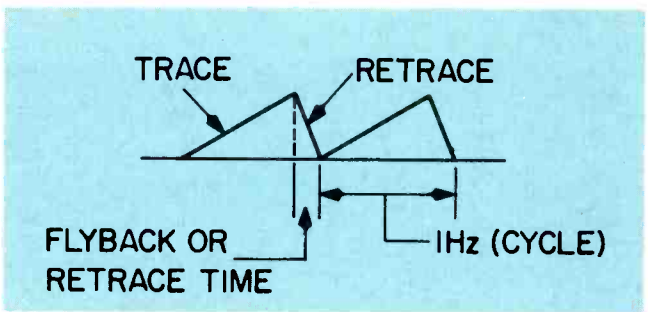


Fig. 3—Two Hz of linear sawtooth trace showing flyback, or retrace time.

■ Previous articles discussed the importance of a scope's vertical amplifier, its capabilities and requirements for modern TV-radio and two-way radio servicing. Basic characteristics and specifications were detailed. But the various specifications for the vertical amplifier in no way constitute the total considerations involved in selecting a suitable scope. The scope must also have a well designed horizontal time-base oscillator and amplifier.

Horizontal Oscillator/Amplifier

An article in the September 1965 issue of ELECTRONIC TECHNICIAN touched briefly on some basic requirements of a scope's linear time-base oscillator, or generator. This sawtooth oscillator may be any form of relaxation-type generator: blocking oscillator, multivibrator or thyratron-type. Variations in relaxation oscillator circuit design may be used to obtain a more-or-less linear sawtooth waveform. One form is the "phantastron" type as illustrated in Fig. 1, which shows the sawtooth amplifier also.

As we already know, the major purpose of the scope's horizontal deflecting system is to move the CRT's electron beam across the screen (X axis) so the frequency (or time) of a waveform can be displayed, determined and observed (See Fig. 2). If this sawtooth voltage is not applied to the horizontal plates of the scope's CRT, the waveform which we wish to observe will appear on the screen as a straight vertical line.

It is important that the scope's time-base generator provide a nearly perfect sawtooth trace — a linear voltage rise—(or lateral deflection of the CRT beam in proportion to time) and a fast retrace (flyback), as shown in Fig. 3.

It may be helpful here to point out that portions of the waveforms shown in Fig. 2 and Fig. 3 are somewhat "idealized." In practical circuitry, neither the sawtooth nor sinewave would appear quite as perfectly proportioned as shown. The flyback time shown on the sawtooth waveform is also exaggerated. Additionally, the sinewave

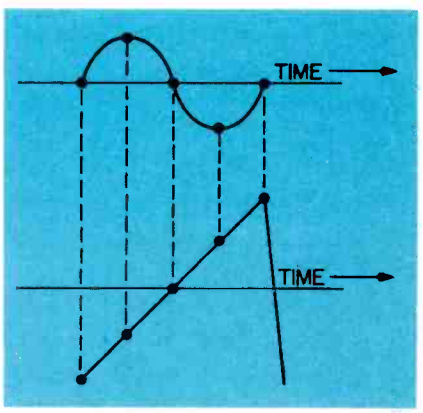


Fig. 2—Relationship between 1Hz of sinewave, timebase sawtooth and time lapse.

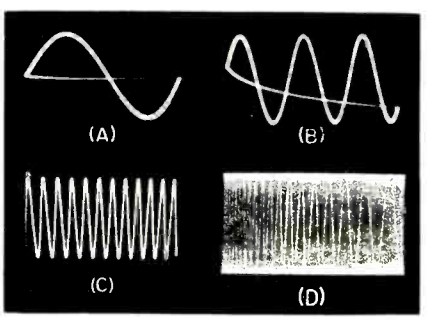


Fig. 4(A)—Single Hz sinewave from 100kHz oscillator with scope timebase frequency set at 100kHz. (B)—Timebase set at 33kHz. (C)—Timebase set at less than 10kHz. (D)—Timebase frequency set too low.

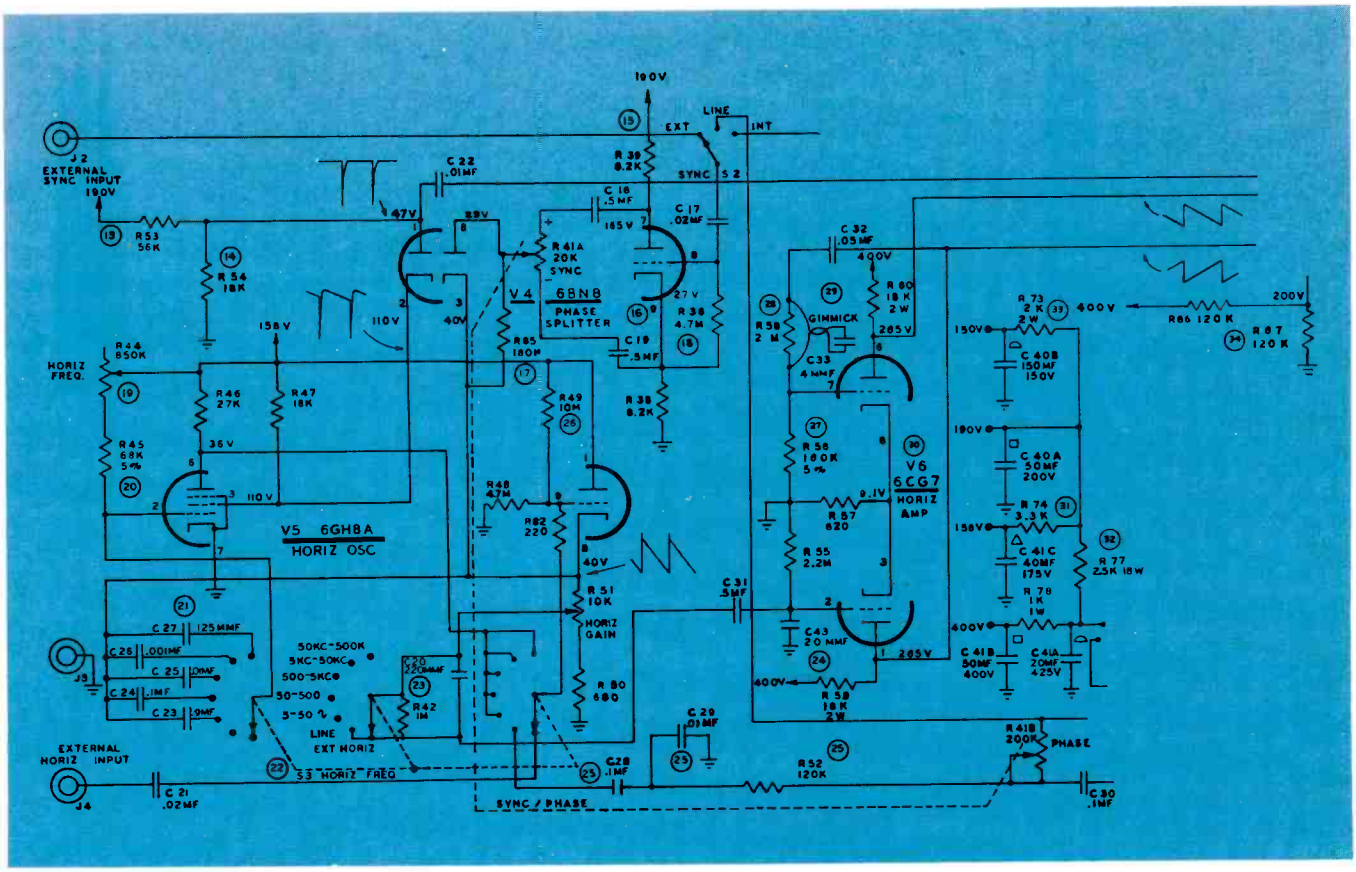


Fig. 1—Horizontal sweep/amplifier and sync section of Sencore PS127 wideband scope.

would not be fully completed before flyback occurs. At higher vertical input frequencies this would become obvious on the scope screen if one cycle (Hertz) of a sinewave is displayed. In practical applications, however, we need not consider this if the flyback time is sufficiently brief and when the time-base frequency is adjusted to display 2 or 3Hz of the waveform on the scope screen.

A definite relationship exists between the specifications of both the vertical amplifier and horizontal oscillator/amplifier as far as the over-all capability of a good service-type scope is concerned. The frequency response of the vertical amplifier, for example, is not only determined by the passband of the vertical amplifier, it will be greatly influenced — under certain circumstances — by the highest frequency capability of the horizontal sweep generator. Hence, the sweep generator frequency must be considered. Frequency ranges of sawtooth generators in typical scopes suitable for color TV servicing generally range from a few Hz upward to 100, 250 and 500kHz. Both coarse and vernier frequency adjustments are provided—with frequency overlap on the coarse range switch. (See horizontal range switch and circuitry in lower left corner of the schematic shown in Fig. 1.)

A range to 50kHz is generally adequate, however, for observing most pulses encountered in TV-radio work. A higher sweep generator frequency offers few advantages in practical work unless other refinements are included. We will cover this subject in a forthcoming article.

The relationship between the frequency of the waveform to be observed and the frequency of the time-base generator will determine the number of cycles (Hertz) which you can observe on the scope screen. In most practical applications the frequency of the sawtooth waveform will be either *less* than that of the signal being observed or *equal* to the signal frequency. It will seldom be higher since, in this case, we would only see a portion of the waveform on the scope screen.

As shown in Fig. 4A, for example, a single sinewave from a 100kHz oscillator is displayed on the scope screen when the frequency of the scope's sawtooth generator is set at 100kHz. Since we generally display at least 2Hz of any waveform, we could easily use a scope with a 50kHz sweep frequency limit to check this waveform. The display at Fig. 4B shows the sweep frequency adjusted to beyond 33kHz and Fig. 4C shows the same frequency sinewave signal with the sweep frequency set at less than 10kHz. In Fig. 4D the sweep frequency is set too low, resulting in a rectangular block of light caused by compressed sinewaves which reveal no information of value.

Associated Controls

In addition to the horizontal frequency range switch and vernier frequency control, two other major controls are involved in the horizontal sweep section. These are the

horizontal gain and positioning controls.

As shown in Fig. 5A, the electron beam spot is centered on the scopes screen by the horizontal and vertical centering controls. The horizontal control moves the spot right or left and the vertical centering control moves it up or down.

In Fig. 5B, the horizontal gain control is used to expand the spot, or time-base; Fig. 5C shows the timebase sweep further expanded and Fig. 5D shows it expanded beyond the right and left edges of the scope screen. These photos were made with no signal on the scope's vertical plates.

As with the horizontal frequency setting, it is very important that the horizontal gain control be properly set when displaying waveforms. Otherwise, the waveform can appear to be something that it isn't. The sinewave displays shown in Fig. 6A, B and C show the horizontal gain control set at three different amplitude levels. The gain at 5C has been increased so much that parts of the display, right and left, are off the screen and do not show. This is not necessarily a disadvantage, however.

A forthcoming article will cover functions and proper adjustment of other scope controls. ■

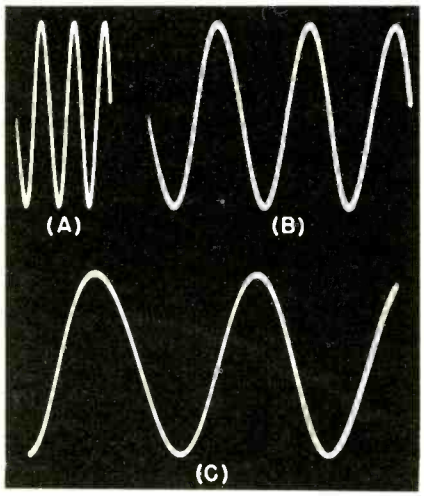


Fig. 6A, B and C—Three Hz sinewave at various settings of the horizontal gain control. The beginning and end of the pattern at C is off screen.

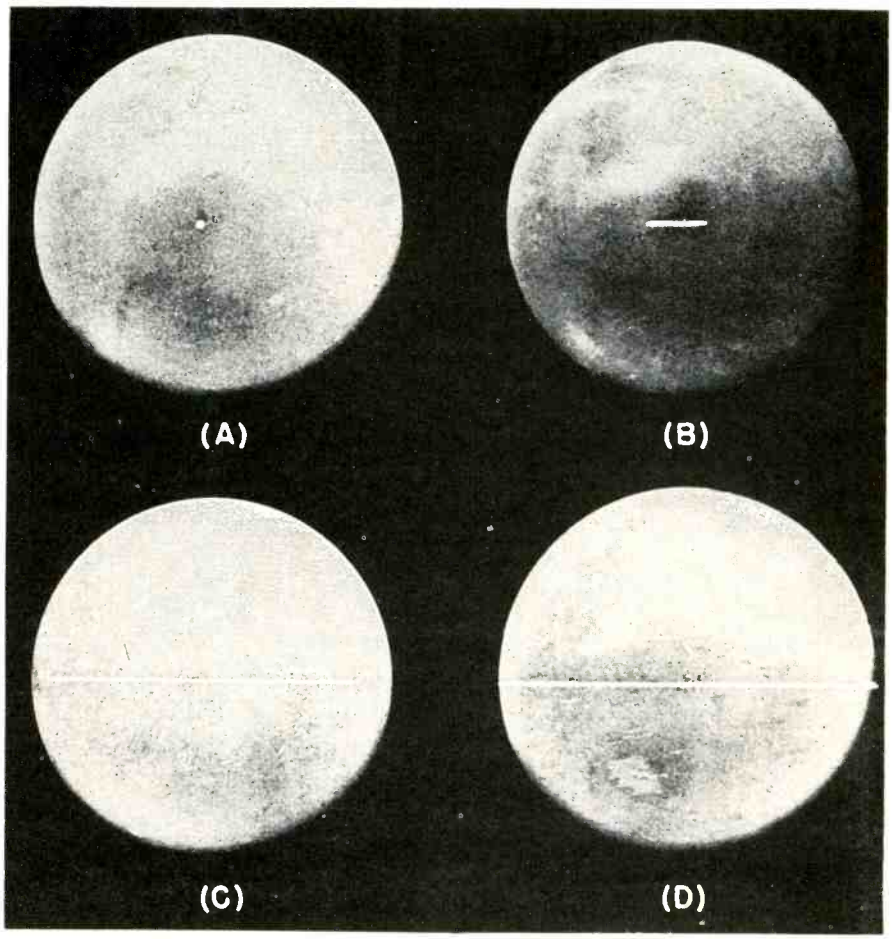


Fig. 5(A)—Electron beam centered in scope screen by using vertical and horizontal positioning controls. (B)—Spot expanded by using horizontal gain control. (C)—Normal expansion by increasing horizontal gain. (D)—Abnormal expansion.

Transistors—Diodes—And Negative Resistance

Understand how the minus sign in a mathematical equation has become a reality

Because of its industrial applications, silicon controlled rectifiers are important semiconductor components.

■ The knowledge explosion in semiconductor circuit technology has made negative resistance an understandable reality. The facts are already before us in simple and economical TV sweep and sync circuits. They are eliminating vibrators and dynamotors in two-way radio. They make rugged, low noise, RF preamps for communications.

Earlier electronic circuits displaying negative resistance were really applications of feedback and could only be analyzed on that basis. The negative resistance did not result from a natural or intrinsic property of the components. But solid-state components are different. They display inherent negative resistance characteristics. The negative resistance results from good, physical reasons—and it exists at the terminals of the component independent of the external circuit. What does this mean in the work-a-day life of TV-radio and industrial electronics technicians? Plenty.

When the point contact transistor was first introduced, we got our first experience with a true negative resistance circuit element. It displayed a negative resistance region without feedback. It was the nature of the beast! Very shortly, numerous other semiconductor components were introduced that displayed this property. Some of these were and are: unijunction transistors, silicon controlled rectifiers and switches, hook collector transistors, four layer diodes, field effect transistors (already important in Hi Fi equipment) and tunnel diodes.

Millions of these components, in circuits that operate *because* of their negative resistance characteristics, are being used today. The number will soon be in the billions—in TV and radio, industrial and space technology. *To understand these circuits we must now come to grips with an apparent impossibility — negative resistance.*

But What Is Negative Resistance?

Familiar Ohm's law defines resistance as the ratio of voltage to current. So we can have negative resistance when either voltage or current is negative. In other words, we can have two different kinds of negative resistance:

$$\text{Negative } R = -E/I$$

and

$$\text{Negative } R = E/-I$$

Mathematically, at least, two different kinds of negative resistance are possible. Before solid-state electronics, this was about as far as negative resistance got — a minus sign in a mathematical equation.

Now we go further. We have physical components with negative resistance regions and there *are* two kinds. They may seem impossible and they may appear confusing, but they are very useful. What is more important, it is necessary to understand the phenomena involved.

The idea of negative resistance is confusing because we tend to think in terms of a negative *resistor* —a physical thing we can lift and feel. No such thing exists. Even if

Transistors Diodes—and Negative Resistance

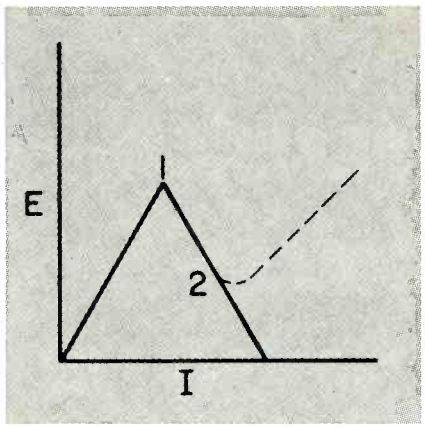


Fig. 1—The area between points 1 and 2 represents a current stable negative resistance region.

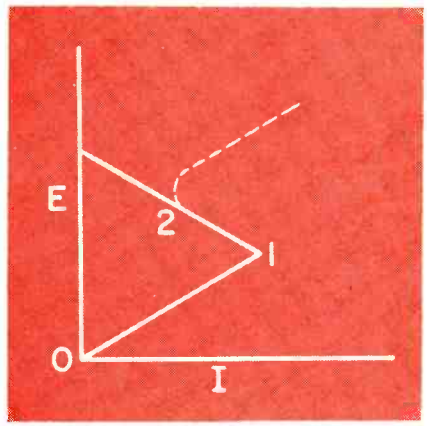


Fig. 2—The region between points 1 and 2 is typical of the voltage stable negative resistance of a practical component.

it did, there would still have to be two different kinds. One, represented by the first formula, would have the unique property of developing a voltage across it that increased as the current increased, but it would have a polarity to *increase* the flow of current. The negative *resistor* represented by the second formula would be an equally strange gadget. As the voltage across it increased, more and more current would flow *out* of it. Obviously, both are physical impossibilities.

Negative resistance in a practical component actually appears as a region in the voltage-to-current relationship where the *usual increase of one results in a decrease of the other*. What is known as current stable negative resistance, because only one possible voltage value exists for a given current, is shown in Fig. 1. It is sometimes called open circuit stable. Don't let this throw you—read on. As the current through the component increases from point 0 to point 1, a voltage drop appears across its terminals. Then after point 1, further increase in current causes a decrease in this voltage drop. In other words, there is a region in the volt-ampere curve that follows the relationship of our first negative resistance equation. This is the region between points 1 and 2 on the curve. If nothing changed after this point, the current could be increased to a point where the voltage drop falls to zero. A practical component, however, breaks over into another positive resistance region as shown by the dashed line. With this type of negative resistance, the net resistance of the component starts to decrease at point 1 and continues to do so until point 2, where it then starts to increase again.

The curve of a practical component with a region of negative resistance that fits the second formula is shown in Fig. 2. As the voltage across it rises from point 0 to point 1 current flows as in an ordinary resistor. When the voltage rises past point 1, the current starts to decrease. If it continued along the line from 0 to 2, it would eventually become zero. An actual component with this characteristic makes the change at point 2 shown by the dashed line, and the current starts to increase again in a second region of positive resistance. This type of negative resistance causes a net *increase* in the resistance across the terminals as it passes through the negative resistance portion. This is a voltage, or short circuit, stable characteristic.

These curves may be examined another way. The first one represents a solid-state switch that *closes* as the current increases. Components with the characteristics shown in Fig. 2 represent a switch that *opens* with increasing voltage. These characteristics make these components ideal elements in switching circuits, multivibrators and flip-flops.

The concept of negative resistance may still seem to be a contradiction, especially if the region from 0 to 1 appears to be 100Ω and the region from 1 to 2 appears to be a negative 1K. A confusing situation exists; what is the total resistance? We can see from both curves: *positive current is always flowing, the net resistance is always positive and the component continues to dissipate real power.* To skirt some of this confusion some people refer to *negative resistance regions* or *dynamic negative resistance* to indicate that special conditions are necessary to obtain it.

Of what value are components with these characteristics? Enough to make them an important new class of circuit element! By biasing these components in or near the negative resistance region with dc, an ac circuit can be coupled to the resulting negative resistance. The added negative resistance can be used to induce oscillation or boost a signal. (The power delivered by the negative resistance comes from the bias supply just as the power gain in a conventional amplifier comes from the dc supply.)

Practical Components

Now that we know something about the two different types of negative resistance, let's look at some of the recently developed components that display this characteristic.

One very useful item is the unijunction transistor. It is a current stable element whose characteristics are similar to those shown in Fig. 1. Strictly speaking, it is not a transistor, but works on transistor principles. It is a bar of semiconductor material with ohmic contacts at each end. In the center, a recti-

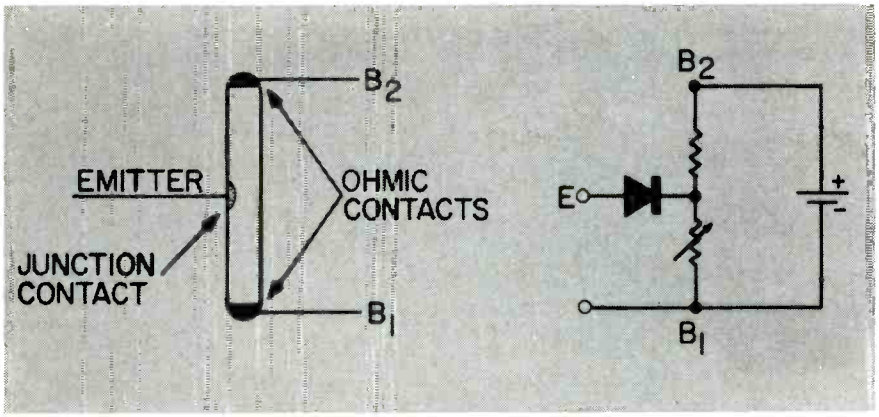


Fig. 3—A unijunction transistor can be represented as a voltage divider with a rectifying contact.

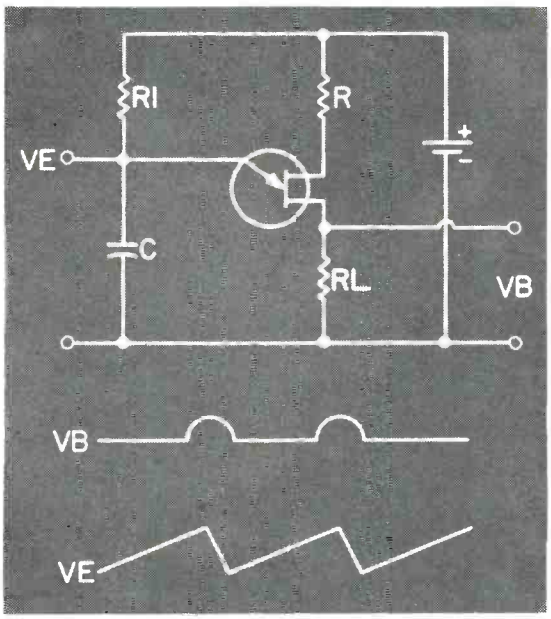


Fig. 5—Simple relaxation oscillators and other voltage sensing circuits can be designed with unijunction transistors.

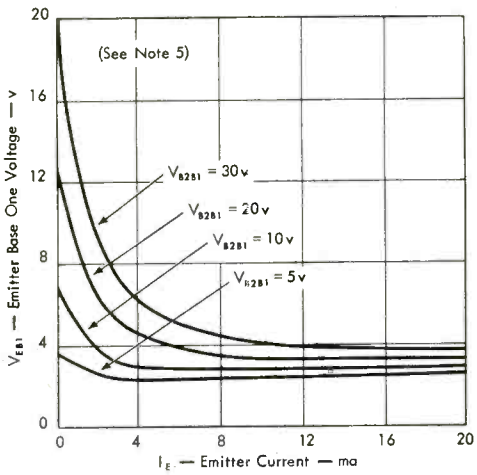


Fig. 4—The firing voltage of a unijunction transistor depends on the supply voltage.

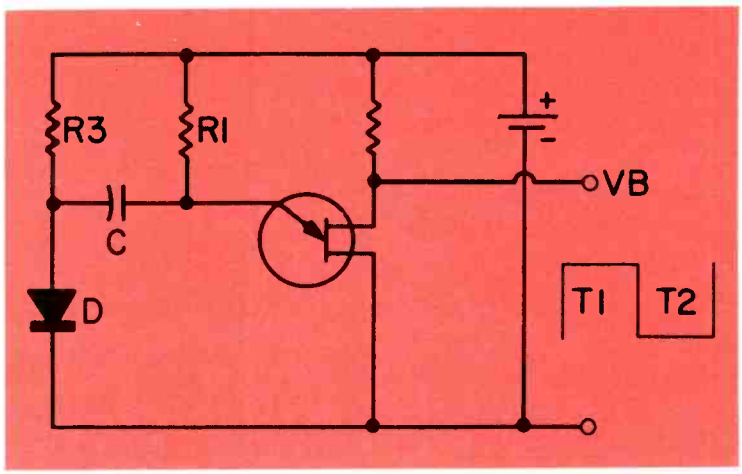


Fig. 6—The negative resistance characteristic of unijunction transistors permit simple multivibrator circuits.

A silicon controlled switch, like the high powered SCR, can be switched into its negative resistance region.
Photos courtesy Texas Instruments.

Fig. 7—The three different load lines show the different operating modes for tunnel diodes.

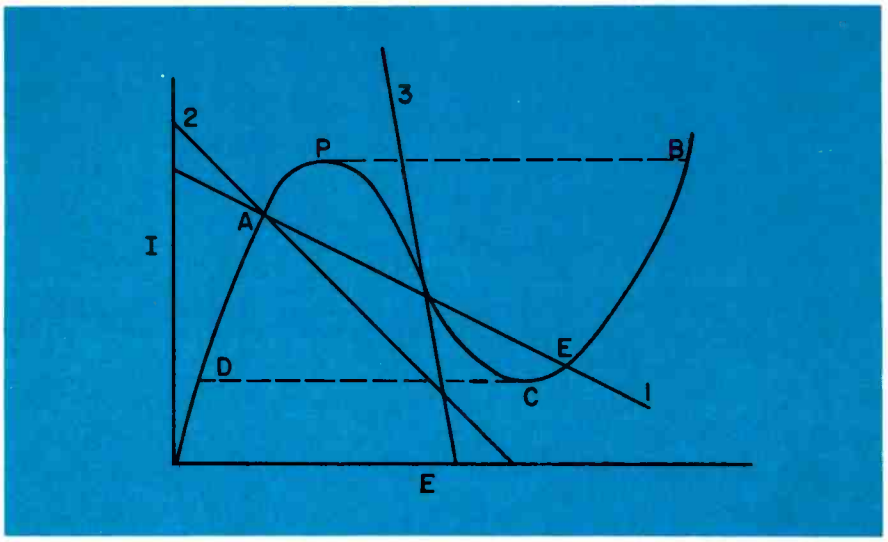
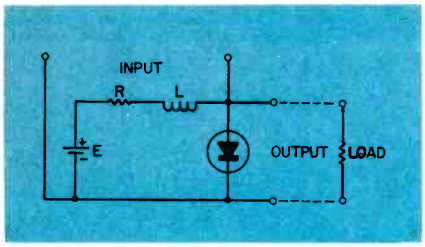


Fig. 8—The equivalent circuit for most tunnel diode uses is sometimes too simple; its HF response causes connection problems.



fying contact is made. A diagram of its construction and its equivalent circuit are shown in Fig. 3.

When a voltage is applied across the bases, voltage dividing action takes place in the bar so that a portion of the voltage appears at the emitter junction. When the applied voltage between the emitter lead and B1 is less than this voltage, the diode appears to be back biased with a high input resistance. When the emitter voltage exceeds this voltage, carriers are injected into the semiconductor causing a negative resistance to appear between the emitter and base 1. The resistance falls sharply. As you can see, this emitter "firing" voltage depends on the voltage across the bases, Vbb. This is shown in Fig. 4, the characteristic curves of a typical unijunction transistor.

These characteristics make the unijunction transistor an ideal element for relaxation oscillators. It takes the place of a neon lamp, or gas discharge tube—but it has a great deal more flexibility—because the "firing" voltage is not a fixed characteristic of the element. A unijunction relaxation oscillator is shown in Fig. 5. The capacitor "C" charges slowly through R1 until the negative resistance region is reached. Then the emitter junction becomes forward biased and "C" discharges through the emitter junction and R2 — causing a voltage pulse at the base connection.

If the RC circuit at the emitter is eliminated, the circuit becomes voltage sensing. A current pulse appears at the base when the unknown emitter voltage exceeds the firing voltage.

A unijunction multivibrator circuit of exceptional simplicity is shown in Fig. 6. The time t1, when the unijunction is not conducting heavily, is determined by the charging time of the capacitor (through R1 and the diode) to reach the firing voltage. The time t2 is determined by the discharge time through R3 and the unijunction. During this time the emitter-to-base resistance is lowered and the transistor conducts more heavily.

Unijunction transistors are ideal components for television sweep and sync circuits, especially in the AFC of horizontal sync circuits. In counter circuit applications they have no equal—at this development point in the state of the art.

SCRs

Silicon controlled rectifiers are another important component with current stable negative resistance characteristics. This unit can have very high resistance until a small gate current drives it into its negative region. Then the resistance drops to a very low value. It performs like a thyratron. Because it is a solid-state device, with no auxiliary power required, and small signal requirements, it is much more useful. It is used as a sparkless switch, a combination rectifier and regulating element, a static inverter

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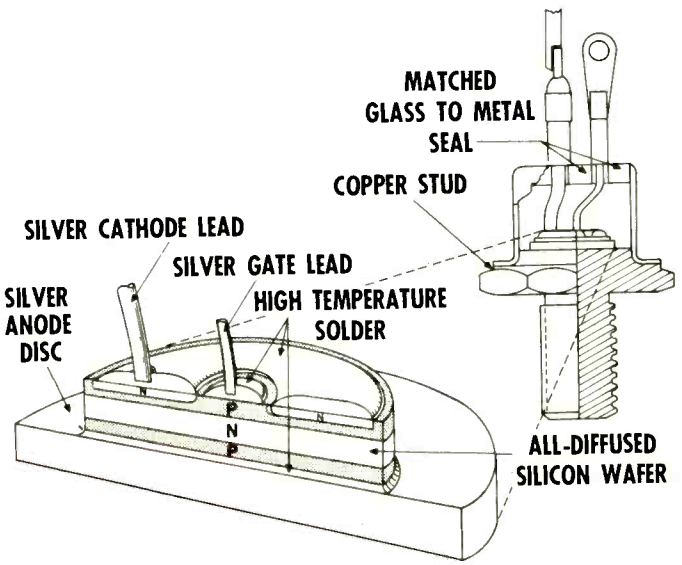


Construction of a typical Silicon controlled rectifier.

YOU & COLOR TV

Develop an organized approach to chroma circuit troubleshooting

■ In this series we have constantly stressed using your scope when checking or troubleshooting color TV chroma sections. This approach will continue and this article will cover scope applications to an RCA-type demodulator color-amplifier circuit.

The secret of efficient troubleshooting with the scope is to know the normal waveforms and be able to recognize an abnormal situation. You should use your scope in diagnosing trouble on all chroma bench jobs even those jobs you consider simple. By doing this you will become more familiar with the instrument and be able to use it more effectively.

The schematic of a typical chroma circuit is shown in Fig. 1. Lets look briefly into circuit operation.

The chroma signal output from the bandpass amplifier is fed to pin 1 of the control grids of each 6GY6 and the suppressor grids are driven by two 3.58MHz signals which are phased approximately 75deg apart. With these two signals applied, the average output appearing at the plate of V23 is the B-Y color voltage and the R-Y voltage is present at the plate of V24.

The B-Y signal is coupled through C738 to the B-Y amplifier grid and the R-Y information is amplified by the R-Y amplifier, V26A. The cathodes of the three amplifiers are tied together and as a result the G-Y amplifier is cathode driven by a portion of the B-Y and R-Y signals. These signals produce the G-Y signal at the output of this stage. These three outputs are then applied to the proper CRT grids and mixed with the luminance signal appearing at the cathodes of the CRT.

Using Color Generator and Scope

The RF output of a keyed rainbow generator is connected to the antenna terminals of the color receiver, in this case a Setchell-Carlson U802 chassis. The generator output is adjusted so that 9v P-P of chroma information [Fig. 2 (A)] appears at chroma unit terminal 14.

The waveform shown in Fig. 2(B) was taken at pin 2 of the chroma amplifier, V18A. It shows that the low frequency components are blocked by C741. You should also have about 9v of chroma signal at this point. With the color control set to give about 14v of chroma information at the control grid of either 6GY6 demodulator, we have another convenient test point [Fig. 2 (C)].

The oscillator signal appearing at pin 7 of V23 is shown in Fig. 2 (D) and the 3.58MHz component at pin 7 of V24 is illustrated in Fig. 2(E). Absence of these signals indicates a dead oscillator.

The input to the R-Y amplifier (V26A, pin 7) is shown in Fig. 2(F) and Fig. 2 (G) shows the Z demodulator output at pin 7 of V25A. The combination of B-Y and R-Y voltages appearing at pin 3, (V26B, the G-Y amplifier) is shown in Fig. 2(H).

The color difference amplifier outputs are shown in Fig. 3 (1) is the R-Y signal, 3 (2) the B-Y and the G-Y component is represented by Fig. 3 (3). These waveforms are taken at the respective grids of the CRT.

As established previously these

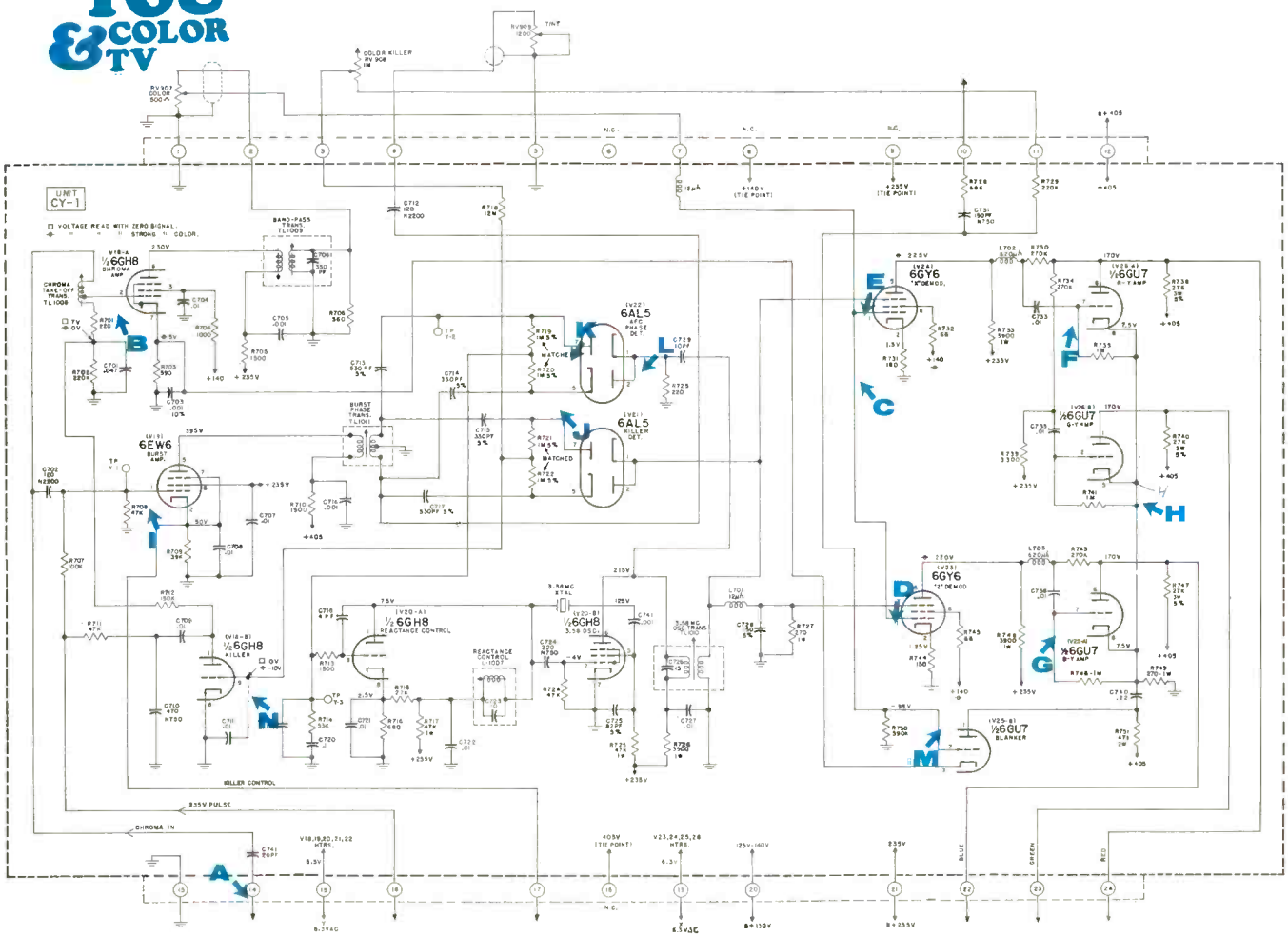


Fig. 1—Schematic of chroma section of a typical color receiver.

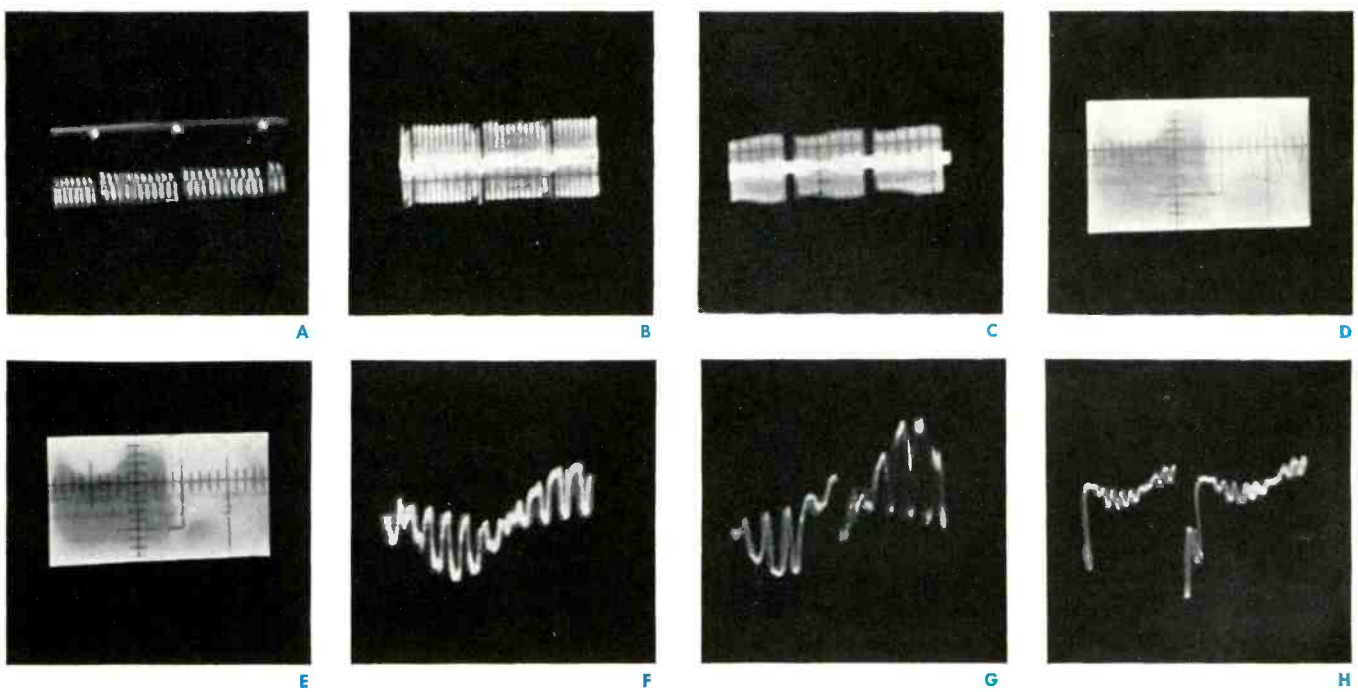


Fig. 2(A)—Normal waveform at testpoint A (chroma voltage 9v P-P). (B)—At TP B (9v P-P). (C)—At TP C (14v P-P). (D)—At TP D (32v P-P). (E)—At TP E (32v P-P). (F)—At TP F (28v P-P). (G)—At TP G (25v P-P). (H)—At TP H (10v P-P).

waveforms were taken on a normally operating color receiver with the modulated RF output of a keyed rainbow generator fed into the antenna terminals. Throughout the following procedures the generator will remain connected to the antenna and its output will be set for 9v P-P chroma voltage at the input to the chroma amplifier.

As mentioned in a previous article, some of the faults which may be shown here will appear simple but the primary idea is to establish a systematic approach to all problems—whether routine or difficult. As we display the various circuit faults note the changes that take place in the waveforms at our testpoints. Faults shown here will be confined to the demodulators, oscillator and color amplifiers. A later article will concentrate on other sections of the circuitry.

Circuit Faults

The oscillator section of V20B has been disabled by ungrounding pin 7 (cathode). This results in no color. Our first testpoint is unit terminal 14 (TPA). A normal scope reading is obtained. Now we move the low-capacity scope probe to pin 1 (grid) of V24 (TPC). Here the chroma signal is absent.

The chroma signal is obviously not reaching the demodulator grids so we back the probe to the chroma amplifier tube plate (V18-A) and find the chroma signal missing. This leads us to suspect this stage so voltage checks are made. With a strong color signal applied we find a -12v at pin 2 of V18A. The normal reading is zero. This high negative reading indicates probable improper color killer operation. Since the color killer is dependent on the local oscillator a scope check of the oscillator output is in order. The absence of a waveform at pin 7 of V24 (TPE) tells us that the oscillator is inoperative. Resistance checks of the oscillator stage will locate the fault.

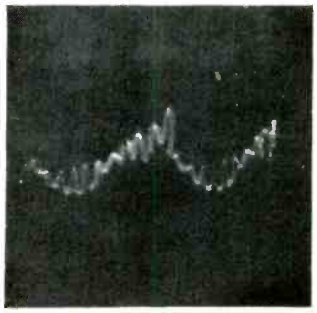
When the choke, L701, in the oscillator plate circuit opens, it causes the blue information to disappear from the screen. Our first testpoint in this case would be the blue grid of the CRT. An abnormal waveform appears as shown in Fig. 4. Next we move the scope probe to the grid of the B-Y amplifier (pin 7) (TPG). The incorrect waveform we observe (Fig. 5) indicates that the problem lies prior to the B-Y amplifier. A scope check of pin 7 of the Z demodulator (TPD) reveals the 3.58MHz component missing. The 3.58MHz signal is present at the secondary of the 3.58MHz oscillator transformer. This indicates that the oscillator is operating. Further probing with the scope will pinpoint the fault.

When R731 in the cathode of V24, the R-Y demodulator, opens the red disappears from the screen. Our first checkpoint is the red grid of the CRT (Fig. 6). This improper waveform leads us to either a faulty demodulator or oscillator trouble. Next the control grid and suppressor grid of V24 (the X demodulator) are checked. Normal scope readings are obtained so the problem is narrowed to the R-Y demodulator and resistance checks would find the trouble.

When L702 in the plate circuit of the X demodulator opens, we again lose the red component on the screen. The presence of R-Y information at the plate of V24 and its absence at the grid of the R-Y amplifier leads us to the fault.

If L703 opens, we lose the blue component and the absence of the waveform at pin 7 of the B-Y amplifier pinpoints the trouble.

In forthcoming articles we will delve further into application of the scope and color generator to this and other color TV receivers. ■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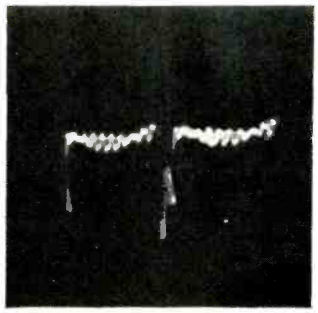
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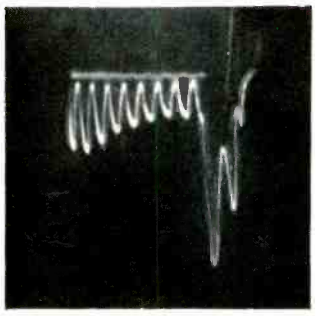
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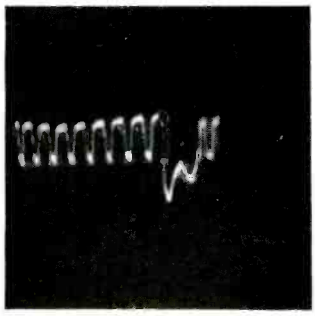
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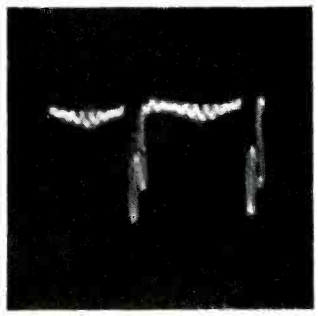
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Fig. 3(1)—Normal waveform at red grid of CRT (240v P-P). (2)—Normal waveform at blue grid (240v P-P). (3)—Normal waveform at green grid (140v P-P).

Fig. 4—Waveform at CRT blue grid with L701 open.

Fig. 5—Waveform at testpoint G with L701 open.

Fig. 6—Waveform at red grid with R731 open.

COLORFAX

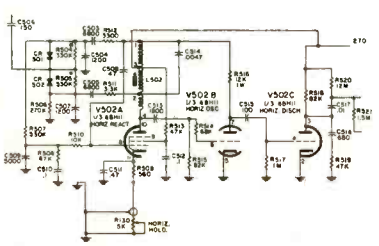
G-E CB Horizontal Oscillator

V502 is a 6BH11 compactron containing a reactance control pentode section, V502A a triode oscillator, V502B, and a horizontal discharge triode V502C.

The sinewave oscillator V502B has a balanced tank coil, L502, connected to the plate through R516 and to the grid through C513 and R514. The portion of L502 between terminals 1 and 2, in parallel with C514, is the balanced tank coil which determines the frequency of the oscillator. The center tap at terminal 3 is connected to ac ground at B+ 270v. The section of L502 between terminals 2 and 4 is autotransformer-coupled to the balanced tank coil and provides feedback to the grid to sustain oscillations.

The reactance pentode V502A is also connected across the balanced tank coil. C508 connects coil terminal 1 to the grid with a phase shift of 90° out of phase with the plate which makes V502A look like a reactance to L502. The plate of V502A is connected to terminal 2 of L502 through the oscillator feedback winding of the coil. This series inductance also prevents V502A from unbalancing the frequency-determining tank circuit.

The horizontal phase detector CR501-CR502, although balanced, functions in basically the same manner as in monochrome receivers. Sinewave reference voltages from terminals 1 and 2 of the coil are connected respectively to the anodes of CR501 and CR502. This action alone will produce a zero voltage output from the phase detector due to cancellation of equal but oppositely-polarized voltages across R504 and R505. In the same manner, a zero voltage will be produced if horizontal negative sync pulses alone from the sync separator through C506 are connected to the common cathodes of CR501 and CR502. Any change in the oscillator frequency will unbalance the phase detector and produce a correction voltage at the anode of CR501 which is fed to the grid of V502A in parallel with L502. The change in reactance returns the oscillator to the correct frequency. R508, C509 and C510 provide damping to prevent oscillator hunting. The RC networks C503, C504, R512 and C505, C507, R511 act as low-pass filters to prevent coupling of sync pulses to the oscillator circuit. R506 is the grid return to ground for V502A. R130 is the horizontal hold control which can vary the effective reactance of V502A.



Returning to the oscillator V502B, the waveform at the grid is a sinewave with the positive half-cycle clipped. This waveform, along with the shaping network R516, R517 and C515, produces a modified square wave at the plate of V502B and the grid of the horizontal discharge triode V502C.

The purpose of the discharge triode is to prevent oscillator phase shift due to variations in the output circuit of V103 which otherwise might cause such undesirable conditions as top curl in the picture. The waveform at the plate of V502C is shaped by C516 and R519 and coupled to the grid of V103 through C517 and R131.

Sylvania Increases Color CRT Output

Sylvania Electric Products, Inc. announces plans to increase by 50 percent the production capacity of its color television picture tube facility located in Seneca Falls, N. Y.

Merle W. Kremer, senior vice president of the company in charge of the electronic components group, said the additional capacity is needed to maintain Sylvania's continued growth in the rapidly expanding color television market.

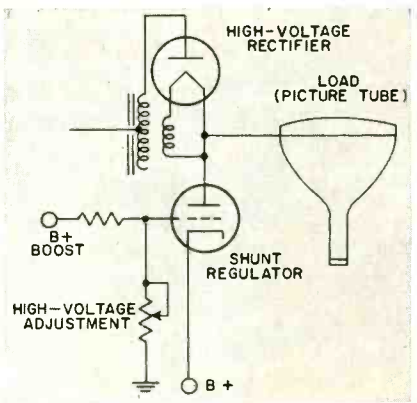
Mr. Kremer said the multi-million dollar program will be in addition to an extensive expansion program which is underway at the company's tube facility in Ottawa, Ohio. In Ohio, Sylvania has erected a 158,000-sq-ft addition to an existing 322,000-sq-ft, black-and-white tube plant. The Ottawa addition, which will be in full production in the fourth quarter of 1966, will be devoted exclusively to the manufacture of color tubes. Initial production in the new addition is expected to start soon.

The Seneca Falls expansion, the third major color expansion at this location since 1962, will be started immediately and will be completed in the first quarter of 1967. The Seneca Falls expansion will involve the construction of an 18,000-sq-ft addition, Mr. Kremer said, but most of the expansion will be accomplished by a realignment of operations within existing buildings and the installation of additional equipment.

When all current division expansion programs at Seneca Falls and Ottawa are completed, Mr. Kremer reported, Sylvania will have a color TV tube production capacity in excess of 2,000,000 tubes on an annual basis, with approximately 60 percent of the capacity at Seneca Falls.

High-Voltage Regulator

High voltage in a color television receiver must be kept constant at all levels of picture tube beam current to prevent blooming and changes in raster size as the brightness level of the picture changes. Voltage is kept constant by a shunt regulator circuit.



The triode acts to maintain a constant load on the high-voltage supply. When the signal drives the picture down to the darkness level, CRT beam current is cut off, and maximum current flows through the regulator. At the highest brightness level, regulator current drops to its minimum value. Thus, load current on the power supply is held constant, and high voltage remains at a fixed level.

Grid voltage for the regulator tube is taken from a voltage divider in the B + boost supply. The voltage operating point is determined by the setting of the high-voltage adjustment. This

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control is set so that the regulator tube passes enough current to absorb the current load of the supply when the picture tube is cut off (black).

If high voltage starts to decrease because of increased beam current, the B+ boost voltage also drops and the grid of the triode becomes less positive. Regulator-tube plate current decreases to compensate for the increase in picture-tube beam current.

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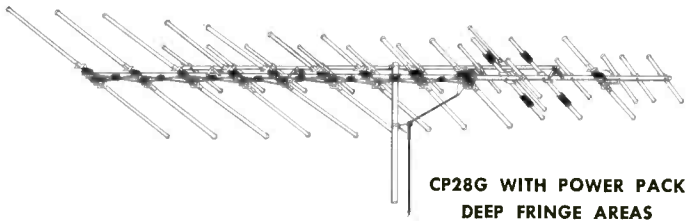

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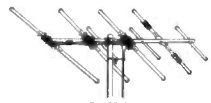

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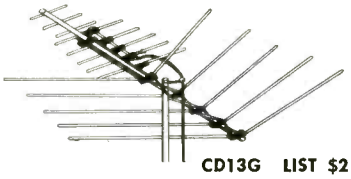

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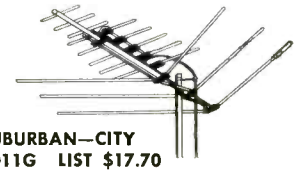

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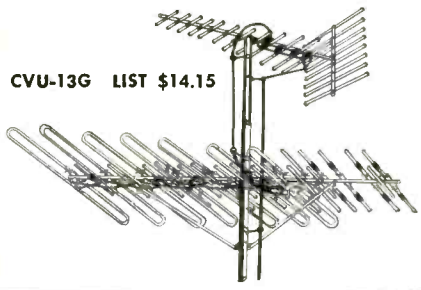

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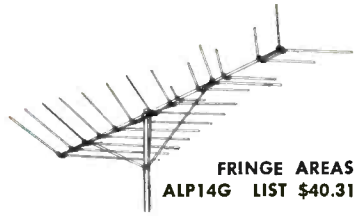

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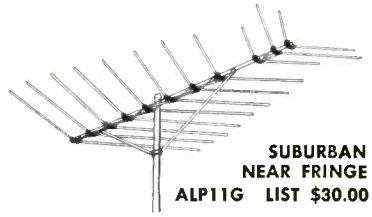

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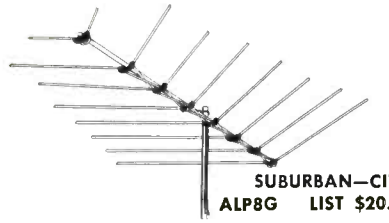

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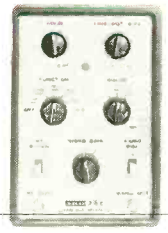

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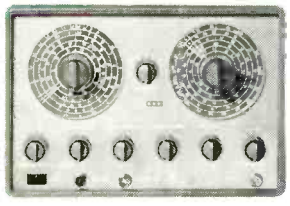

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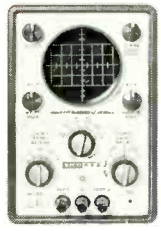

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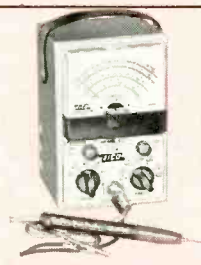

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Elgin Advance Relays 2435 W Naomi St Burbank Calif
Elpha Marketing-Thorens Atlantic & Steward Ave New Hyde Park NY
Eltec Labs 14 Alsop Ave Middletown Conn
EMC 625 Bway New York NY
Emerson Radio & Phono 14 & Coles Jersey City NJ
Empire Scientific 1075 Steward Ave Garden City LI NY
Enterprise Development Corp 5123 E 65th Indianapolis Ind
Entron 2141 Industrial Pkwy Silver Springs Md
Ercona Corp 16 W 46 St New York NY
Essex Wire 1601 Wall St Indianapolis Ind
Euphonics Corp PO Box 2746 Rio Piedras Puerto Rico USA
Eveready Batteries (see Union Carbide Co)
Exide Ind Div Electric Storage Battery 52 S 15 St Philadelphia Pa

F

Fanon-Masco 439 Frelinghuysen Ave Newark NJ
Fidelitone Inc 6415 Ravenswood Ave Chicago Ill
Finney Co 34 W Interstate St Bedford Ohio
Fischer Special Mfg Co 446 Morgan St Cincinnati Ohio
Fisher Radio 21-24 44 Dr Long Island City NY
Foxboro Co NewPonset Ave Foxboro Mass
Freed Transformer 1718 Weirfield St Brooklyn NY

G

GAM Electronics 138 Lincoln St Manchester NH
Gator Probe Corp 2751 San Juan Rd Hollister Calif
GC Electronics 400 S Wyman St Rockford Ill
Garrard Sales 80 Shore Rd Port Washington NY
Gavin Instruments Depot Sq & Div St Somerville NJ
General Dynamics/Electronics 1407 N Goodman St Rochester NY
General Electric Audio Products Div Decatur Ill
General Electric Communications Products Div Lynchburg Va
General Electric Receiving Tube Dept Owensboro Ky
General Electric Receiver Div Utica NY
General Instrument 65 Gouveneur St Newark NJ
General Precision GPL Div Mt Kisco NY
General Radio West Concord Mass
General Radiotelephone Co 3501 W Burbank Blvd Burbank Calif
Gertsch Products 3211 S LaCienega Blvd Los Angeles Calif
Greyhound Package Express 140 S Dearborn Chicago Ill
Griffiths Electronics 1301 E Linden Linden NJ

H

H & H Equipment Co Laotto Ind
Hallamore Electronics 714 N Brookhurst St Anaheim Calif
Hallicrafters Co 4401 W 5 Ave Chicago Ill
Hallmark Electronics 436 N 31 St Philadelphia Pa
Hallmark Instruments 2620 Freewood Dr Dallas Tex
Hammarlund Mfg 53 W 23 St New York NY
Harman-Kardon 15th & Lehigh Ave Philadelphia Pa
Hartley Products 521 E 162 St Bronx NY
Hathaway Instrument 5800 E Jewell Ave Denver Colo
Heath Co Benton Harbor Mich
Heintz & Kaufman Ltd 3650 Hayden Ave Culver City Calif
Hewlett-Packard 1501 Page Mill Rd Palo Alto Calif
Hickok Electrical Instrument 10514 Dupont Ave Cleveland Ohio
Hi-Lo Mfg 1122 Newport St Chicago Ill
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Hoffman Electronics Consumer Prods Div 3761 S Hill St Los Angeles Calif
Hollywood Television Wuerth Surgitron Div 1949 Moffett St Hollywood Fla
Honeywell Commercial Residential Div 2753 4 Ave Minneapolis Minn
Hunter Sales RN 9851 Alburtus Ave Santa Fe Springs Calif
Hycon Electronics 1030 S Arroyo Pkwy Pasadena Calif

Hy-Gain Electronics 8473 NE Highway 6 Lincoln Neb
Hysol Co 322 Houghton Olean NY

I

I E H Manufacturing Co 102 Prince St New York NY
IERC Div Box 271 Burbank Calif
Illumitronic Engineering 680 E Taylor St Sunnyvale Calif
Injectorall Co 4 North Great Neck NY
Institute of Electrical & Electronic Engineers (1EEE) 72 W 45th St New York NY
Int'l Business Machines 590 Madison Ave New York NY
Int'l Correspondence Schools Scranton Pa
Int'l Crystal Mfg 18 N Lee Oklahoma City Okla
Int'l Electronics 316 S Service Rd Melville LI NY
Int'l Rectifier 233 Kansas St El Segundo Calif
IRC Inc 401 N Broad Philadelphia Pa
I-T-E Circuit Breaker 601 E Erie Ave Philadelphia Pa
I T&T 320 Park Ave New York NY
IT&T Components 100 Kingsland Rd Cliffton NJ
IT&T Distributor Products 250 Broadway New York NY

J

Jackson Electrical Instrument 124 McDonough St Dayton Ohio
J-B-T Instruments 61 Hamilton New Haven Conn
Jensen Industries 301 Interstate Rd Addison Ill
Jensen Mfg 6601 S Laramie Chicago Ill
Jensen Tools 3630 E Indian School Rd Phoenix Ariz
Jerrold Electronics 15th & Lehigh Ave Philadelphia Pa
Jersey Specialty Co Box 576 Mt View NJ
Jetronic Industries 4312 Main St Philadelphia Pa
JFD Electronics 15 Ave at 62 St Brooklyn NY
Johnson Co E F 6516 10th Ave SW Waseca Minn
Jones & Laughlin 401 Liberty Pittsburgh Pa
Jones Div Cinch Mfg 1026 S Homan Chicago Ill
JW Electronics 1538 W Jarvis Chicago Ill
JW Electronics PO Box 51 Bloomington Ind

K

KLH Research & Devel 30 Cross St Cambridge Mass
KTV Tower & Comm Equip Co PO Box 294 Sullivan Ill
Kaar Engineering Co 2998 Middlefield Rd Palo Alto Calif
Karg Laboratories 162 Ely Ave S Norwalk, Conn
Karlson Assoc 1610 Neck Rd Brooklyn NY
Kay Electric 14 Maple Pine Brook NJ
Kay-Townes Antenna 1511 Dean Rome Ga
Kenwood Electronics 3700 S Broadway Pl Los Angeles Calif
Kepco Inc 131-38 Sanford Ave Flushing NY
Kester Solder 4201 Wrightwood Chicago Ill
Klipsch & Assoc PO Box 96 Hope Ark
Kinematix Inc 2040 W Washington Chicago Ill
Knob Corp of America 469 Jericho Tpk Mineola NY
Koss Inc 2227 N 31 St Milwaukee Wis
Kraeuter & Co 585 18 Ave Newark NJ
Krylon Inc Ford & Washington St Noristown Pa
Kwikheat Mfg 3731 San Fernando Rd Glendale Calif

L

LA Turner Exchange 4611 W Jefferson Los Angeles Calif
Lafayette Radio Electronics 111 Jerico Tpk Syosset LI NY
Lambda Electronics 515 Broad Hallow Huntington NY
Lampkin Labs Bradenton Fla
Lance Antenna 1730 1st St San Fernando Calif
Lansing Sound James B 3249 Casitas Ave Los Angeles Calif
Lavoie Labs Morganville NJ
Leach Corp 18435 Susana Rd Compton Calif
Lectrotech Inc 1221 W Devon Ave Chicago Ill
Ledex Inc 123 Webster Dayton Ohio
Leeds & Northrup 4907 Stenton Philadelphia Pa
Lesa of America 11 W 42 St New York NY
Littelfuse Inc Des Plains Ill
Litton Industries 336 N Foothill Beverly Hills Calif
Los Angeles Turner Exchange 4611 W Jefferson Los Angeles Calif

M

3M Electrical Products Div 900 Bush Ave St Paul Minn
McIntosh Labs 2 Chambers St Binghamton NY
Magnavox Co 2131 Bueter Rd Ft Wayne Ind
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Matsushita Electric Co 200 Park Ave New York NY
Mercury Electronics 315 Roslyn Rd Mineola NY
Mercury TV Tuner Service 890 River Bronx NY
Merit Coil & Transformer Merit Plaza Hollywood Fla
Methode Mfg 7447 W Wilson Ave Chicago Ill
Metrex (UXL Corp) 819 Blake Ave Brooklyn NY
Michigan Magnetics Vermontville Mich
Midland Int Corp 1519-21 Atlantic N Kansas City Mo
Milgray/NY 136 Liberty St New York NY
Millen Mfg James 150 Exchange Malden Mass
Miller Co JW 5917 S Main Los Angeles Calif
Milo Electronics 530 Canal New York NY
Monarch Elec Int'l Inc 7035 Laurel Canyon Blvd N Hollywood Calif
Monitoradio Div Idea 7900 Pendleton Pike Indianapolis Ind
Mosley Electronics 4610 N Lindberg Brideton Mo
Moss Electronics 2435 White Plains Rd Bronx NY
Motorola Communications Div 4501 W Augusta Chicago Ill
Motorola Consumer Prods 9401 W Grand Ave Franklin Park Ill
Motorola Training Int 4545 W Augusta Chicago Ill
Mueller Electric 1583 E 31 St Cleveland Ohio
Mullard (see Int'l Electronics New York NY)
Multicore Sales Corp Westbury NY
Multitron Corp 309 Queen Ann Rd Teaneck NJ
Mura Corp 380 Great Neck Rd Great Neck NY
Muzak Co 220 4 Ave New York NY

N

National Radio Institute Washington DC
Neshaminy Electronics Neshaminy Pa
Newark Electronic 223 W Madison Chicago Ill
Newcomb Audio Products Co 6824 Lexington Ave Hollywood Calif
Newtronics Corp 3455 Vega Ave Cleveland Ohio
North American Philips (Norelco) 100 E 42 St New York NY
Nortronics Co 8133 10th Ave N Minneapolis Minn
Nutone Inc Cincinnati Ohio

O

Oak Mfg Co Crystal Lake Ill
Oaktron Industries Monroe Wis
Oelrich Publications 4308 Milwaukee Ave Chicago Ill
Ohmite Mfg 3673 Howard St Skokie Ill
Olson Electronics 464 S Forge Akron Ohio
Olympic Radio & TV 34-01 38 Ave Long Island City NY
Ortron Electronics 29 Lincoln Ave Orange NY
Oxford Transducers 3911 S Mich Ave Chicago Ill

P

Packard Bell Electronics 12333 W Olympic Blvd Los Angeles Calif
Pacotronics Inc 70-31 84 St Glendale LI NY
Palmer Electronics Laboratories Lowell Rd Carlisle Mass

Parker Metal Goods Co 85 Prescott St Wooster Mass
Parts Unlimited Inc 1 State St Bloomfield NJ
Pearce-Simpson 2295 N W 14 St Miami Fla
Perma-Power Co 5740 N Tripp Ave Chicago Ill
Phaostron Instruments & Electronics 151 Pasadena Ave S Pasadena Calif
Phelps Dodge Communications Products Div Route 79 Marlboro NJ
Philco Corp "C" and Tioga Sts Philadelphia Pa
Philharmonic Radio & TV 235 Jersey Ave New Brunswick NJ
Pickering & Co Sunnyside Blvd Plainview NY
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Planet Mfg Corp 225 Belleville Ave Bloomfield NJ
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Potter & Brumfield 107 N 10th St Princeton Ind
Precise Electronics 76 E 2 St Mineola LI NY
Precision Electronics Inc 9101 King Ave Franklin Park Ill
Precision Tuner Service PO Box 272 Bloomington Ind
Puramid Electric Co Darlington SC

Q

Qualitone Industries 102 Columbus Ave Tuckahoe NY
Quam-Nichols 234 E Marquette Rd Chicago Ill
Quan-Tech Labs 60 Parsippany Blvd Boonton NJ
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R

Radar Devices Mfg Corp 22003 Harper Ave St Clair Shores Mich
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RCA Institutes 350 W 4 St New York NY
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RCA Set Div 600 N Sherman Dr Indianapolis Ind
RFS Industries 102 Harbor Rd Port Washington NY
RMS Electronics Inc 2016 Bdwy New York NY
Radiart Co 2900 Columbia Indianapolis Ind
Radio Receptor 240 Wythe Brooklyn NY
Radio Shack 730 Commonwealth Boston Mass
Rauland Corp 4245 N Knox Chicago Ill
Ray-O-Vac Co 212 E Washington St Madison Wis
Raytheon Communications Prod 213 Grand S San Francisco Calif
Raytheon Distributor Products Div 55 Chapel Newton Miss
R-Columbia Products 305 Waukegan Ave Highwood Ill
Recoton Corp 52-35 Barnett Long Island NY
Reeves Soundcraft Great Pasture Rd Danbury Conn
Regency Electronics 7900 Pendleton Pike Indianapolis Ind
Rego Insulated Wire 830 Monroe Hoboken NJ
Rek-O-Kut Co 38-19 108 St Corona NY
Rawn Co Spooner Wis
Roberts Electronics 829 N Highland Ave Hollywood Calif
Robert Bosh Corp Blaupunkt Car Radio Div 40-25 Crescent Long Island City NY
Robins Industries 1558 127 St College Pt NY
Rockbar Corp 650 Halstead Mamaroneck NY
Rohn Mfg 116 Limestone St Peoria Ill
Rustrak Instrument 130 Silver Manchester NH

S

Sadelco Inc 601 W 26 NY
S & A Electronics 204 W Florence St Toledo Ohio
SECO Electronics Corp 1205D S Clover Minneapolis Minn
Sadelco Inc 601 W 26th St New York NY
Sampson Co 2244 S Western Ave Chicago Ill
Sangamo Electric 1301 N 11 St Springfield Ill
Sargent Gerkhe Co 323 W 15th St Indianapolis Ind
Sarkes Tarzian Tuner Service 537 S Walnut Bloomington Ind
Sarkes Tarzian Tuner Service 547-49 Tonnele Jersey City NJ
Sarkes Tarzian Tuner Service 10654 Magnolia N Hollywood Calif
Schematic Library 809 N 7th St Phoenix Ariz
Schober Organ 43 W 61 St New York NY
Scott Inc HH 111 Powdermill Rd Maynard Mass
Seco Electronics 1201 W Clover Dr Minneapolis Minn
Semitronics Corp 265 Canal St New York NY
Sencore Inc 426 S Westgate Dr Addicon Ill
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Setchell-Carlson New Brighton St Paul Minn
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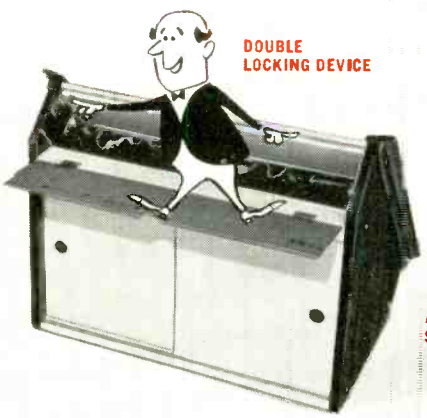
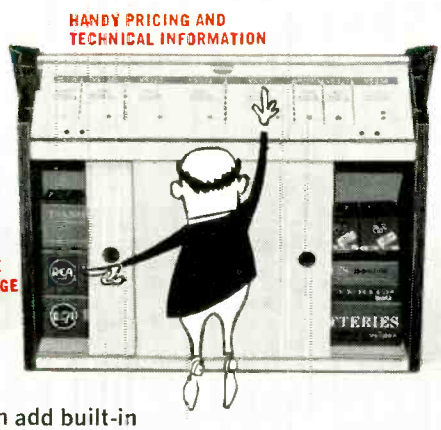
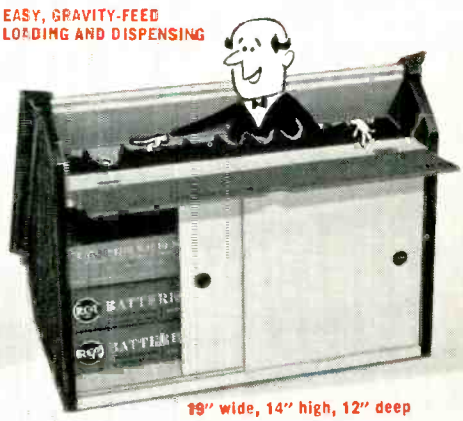
Add real selling convenience to your transistor battery business with

RCA's NEW "TOP 7" COMPACT SHOWCASE

Quality and convenience... inside and out. Its gold anodized aluminum header and genuine walnut trim reflect the smart styling, top quality, and durable construction of this RCA Battery Showcase. Underneath... there's a real inside story of selling convenience.







RCA's "Top 7" Showcase (1P1215) can add built-in eye appeal and real convenience features to the established turnover of the seven fastest-moving transistor battery types for which it was designed. It also accommodates the 1P1182A RCA Battery Tester as an optional accessory. Contact your RCA Battery Distributor and learn how you can add this "new look" to your battery business.

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Sonar Radio 73 Wertman Ave Brooklyn NY
Sonotone Corp Elmsford NY
Sony Corp of America 580 5 Ave New York NY
Sorensen Prods Div Raytheon S Norwalk Conn
Soundolier Inc PO Box 3848 St Louis Mo
South River Metal Products 377 Tpk Rd South River NJ
Sprague Products Marshall St N Adams Mass
Stockpole Carbon Electronics Div St Marys Pa
Stancor Electronics 3501 W Addison Chicago Ill
Standard Instrument Corp 657 Broadway New York, NY
Standard Kollsman Industries 2085 N Hawthorne Melrose Park Ill
Stromberg-Carlson Div General Dynamics 1400 N Goodman St Rochester NY
Steurtevant Co PA Addison Ill
Superior Electronics 208-212 Piaget Ave Clifton NJ
Swing O Lite Inc 13 Moonachie Rd Hackensack NJ
Switchcraft Inc 5555 N Elston Chicago Ill
Sylvania Electric Products 730 3 Ave NY NY
Sylvania Electronic Tube Div Seneca Falls NY
Symphonic Radio & Electronic 10 Columbus Circle N New York NY

T

TACO Sherburne NY
TV Tuner Service 2103 W 3 St Bloomington Ind
TV Tuner Service 118 3rd St W Twin Falls Idaho
Talk APhone Co 5013 N Kedzie Ave Chicago Ill
Tandberg of America 83 Ave Pelham NY
Tap A Line Mfg PO Box 563 Pompano Beach Fla
Tech-Master 75 Front St Brooklyn NY
Techni-Parts Corp 156 Hempstead Tpk W Hempstead LI NY
Techpress Inc Brownsburg Ind
Tektronix Inc PO Box 500 Beaverton Ore
Telerad Div Lionel Corp Route 69-202 Flemington NJ
Telex Inc 3054 Excelsior Minneapolis Minn
Telex/Aemco Div Telex Inc Mankato Minn
Teleonic Industries 60 N 1 Ave Beech Grove Ind
Tenatronics Ltd 1011 Power Ave Cleveland Ohio
Tenna Mfg 19201 Cranbrook Pkway Cleveland Ohio
Tennalab 10 & State Sts Quincy Ill
Terado Co 1068 Raymond Ave St Paul Minn
Texas Crystals 1000 Crystal Dr Ft Myers Fla
Thomas Electronic Organs 8345 Hayvenhurst Ave Sepulveda Calif
Thordarson-Meissner 7 & Belmont Mt Carmel Ill
Thorens Div Atlantic & Stewart Aves ELPA Mktg Ind New Hyde Park NY
Toshiba Mitsui & Co 530 5 Ave New York NY
Trav Ler Radio 571 W Jackson Chicago Ill
Triad Transformer 4055 Redwood Ave Venice Calif
Trio Mfg Griggsville Ill
Triplett Electrical Instrument 286 Harmon Rd Bluffton Ohio
Tung-Sol Electric 1 Summer Ave Newark NJ
Turner Co 918 17 St NE Cedar Rapids Iowa

U

Ullman Devices Ridgefield Conn
Ungar Co Sid 1880 Rayford Dr Los Angeles Calif
Union Carbide 270 Park Ave New York NY
Useco Div Litton Industries Inc 13536 Saticoy St Van Nuys Calif
Utah Electronics 1123 E Franklin St Huntington Ind
U Test M Mfg 4325 W Lincoln Milwaukee Wis
Ungar Electric Tools 2701 W El Segundo Blvd Hawthorne Calif
United Transformer 150 Varick St New York NY
University Loudspeakers Div Ling Temco Vought 9500 W Reno St Oklahoma City
Up Right Towers 1013 Pardee St Berkeley Calif
Utah Radio & Electric Corp 1123 E Franklin St Huntington Ind
Utica Drop Forge & Tool 2415 Whitesboro Utica NY
Utica Electronic Communications 2714 W Irving Pk Chicago Ill

V

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Video Industries Co 242 Madison Ave Portchester NY
Viking Cable Co 400 9th St Hoboken NJ
Viking of Minnesota 9600 Aldrich St Minneapolis Minn
Viking Electronics 830 Monroe Hoboken NJ
Vitramon Inc Box 544 Bridgeport Conn
Vocaline Co of America 133 Coulter St Old Saybrook Conn
Volkswagen of America 476 Hudson Terrace Englewood Cliffs NJ

W

Waber Electronics 200 N 2nd St Philadelphia Pa
Walco Electronics 60 Franklin St East Orange NJ
Waldom Electronics 4625 W 53 St Chicago Ill
Wall Mfg Co P Grove City Pa
Waller Corp Crystal Lake Ill
Wallin-Knight Industries 3321 McKinley St NE Minneapolis Minn
Walsco Electronics S Wyman St Rockford Ill
Ward Leonard Electric 115 McQueston Pkwy Mt Vernon NY
Ward Products Edsom St Amsterdam NY
Weathers Industries 66 E Gloucester Pike Barrington NJ
Webcor Inc 5626 Bloomingdale Ave Chicago Ill
Weller Electric 601 Stone Crossing Rd Easton Pa
Wells-Gardner 2701 N Kildare Ave Chicago Ill
Wen Products 5810 Northwest Hwy Chicago Ill
Western Electric Co Inc 195 Broadway New York NY
Western Tuner Rebuilders 1140 N Vermont Ave Los Angeles Calif
Westinghouse Electric Radio TV Dept Metuchen NJ
Westinghouse Electric Corp Tube Div PO Box 284 Elmira NY
Wilco Co 4425 Bandini Blvd Los Angeles Calif
Windsor Electronics 999 N Main St Glen Ellyn Ill
Winegard Co 3000 Kirkwood Burlington Iowa
Workman Electronic Products Box 5297 Sarasota Fla
Worner Electronic Rankin Ill
Wuerth Tube Saver Corp PO Box 66 Hollandale Fla
Wurlitzer Co N Tonawanda NY

X

Xacto Inc 48-41 Van Dam St Long Island City NY
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Y

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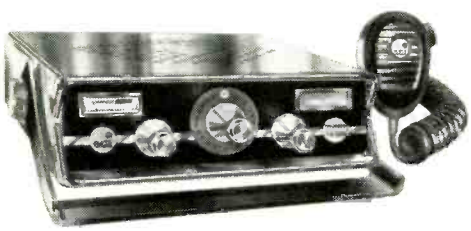

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NEW PRODUCTS

FOR MORE INFORMATION CIRCLE NEW PRODUCT NUMBERS ON POSTCARD INSIDE LAST COVER.

Tuner Cleaner **700**

This tuner cleaner is especially developed for use in color TV tuners

and according to the manufacturer the cleaner does not cause tuner frequency drift upon evaporating. Chemtronics.

Silicon Rectifiers **701**

A five-pack of 1 amp, molded, axial lead silicon rectifiers is introduced.

A perforation on the card enables any number of units to be torn off. The rectifiers are produced by a diffused junction process. Mallory.

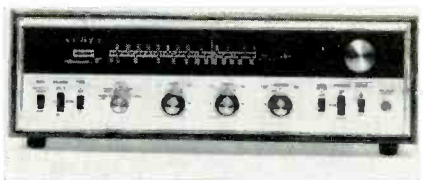
FM/Stereo Generator **702**

A solid-state FM/stereo generator is introduced. It has a stereo signal

available on an RF carrier adjustable from 95 to 105MHz or as composite stereo without RF for injection into the detector. The unit also has two built-in speaker meters to measure the signal output of each channel. The instrument has two 8Ω speaker loads so that the speakers may be disconnected without damaging the receiver under test. Sencore.

Stereo Receiver **703**

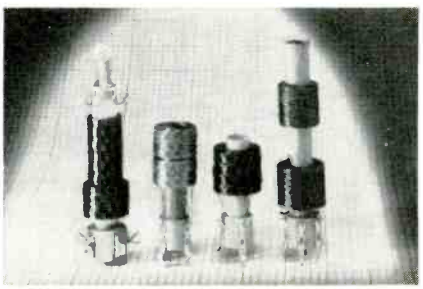
A solid-state AM/FM/FM stereo receiver is introduced. The receiver



uses field effect transistors in both AM and FM front end circuitry. Scott.

Linearity Coils **704**

A line of exact replacement linearity coils for color TV sets made by



more than 25 manufacturers is introduced. The coils are directly interchangeable with the like coils on color TV sets made by major manufacturers. Miller.

VTVM **705**

A general purpose VTVM with a 9 in. display meter is announced. The

instrument measures current and voltage, resistance, capacitance and inductance. Hickok.

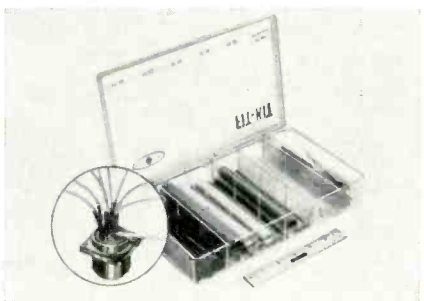
Base Station **706**

A series of radio base stations is introduced. The desk unit is 5¾ x

20 x 13¾ in. The wall model is 21¼ x 22½ x 6⅞ in. G-E.

Shrinkable Tubing **707**

A kit containing a selection of 6 in. lengths of all types of heat shrinkable tubing is announced. The kit is

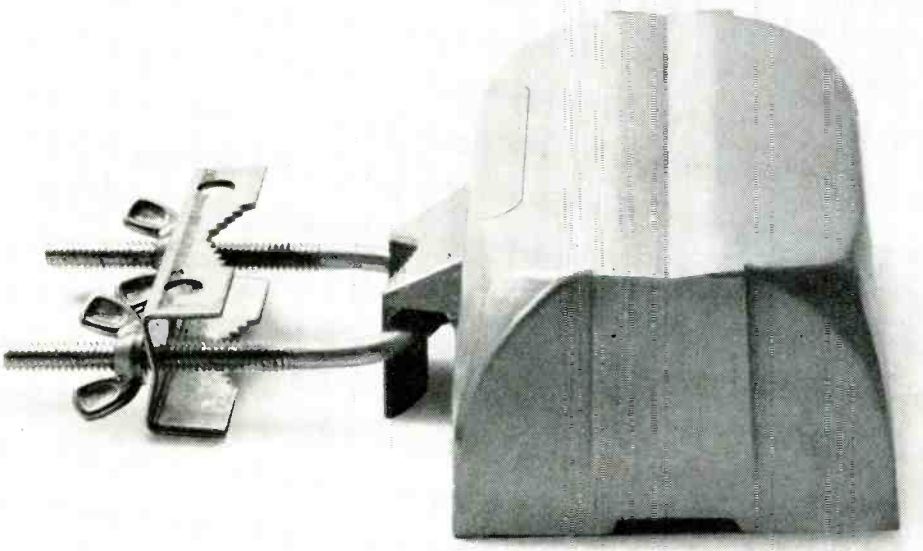


packaged in a compartmented clear plastic box with the tubing type indicated on the cover. It is designed for engineers, laboratory use and prototype work. Alpha.

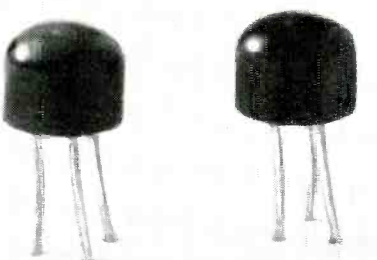
Stereo Receiver **708**

An FM stereo receiver using silicon transistors is introduced. The receiver

is rated at 130w at 4Ω and 100w at 8Ω. Sherwood.



How do you make a great TV amplifier even better?



Give it the silicon treatment.

The result: 40% more gain in the lowband, 100% more in the highband, greater ability to handle strong signals without overloading and better signal-to-noise ratio. These dramatic improvements mean even better reception of color or black-and-white TV. And you get an added bonus because silicon transistors are more rugged, run cooler and are more stable. The use of silicon transistors, as in our Vamp-2 and Vamp-2-75, is another Blonder-Tongue first. Both amplifiers have rugged, weatherproof amplifier housings with remote power supply. Both have two silicon transistors. Both are easy to install. Both deliver sharp pictures to as many as 8 TV outlets. The Vamp-2 is for 300-ohm systems; the Vamp-2-75 for 75-ohm coaxial cable. Vamp-2-75 lists for $44.95; Vamp-2, $38.95.

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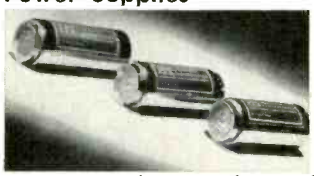
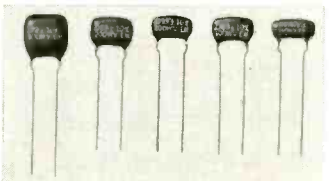
Power Supplies **709**



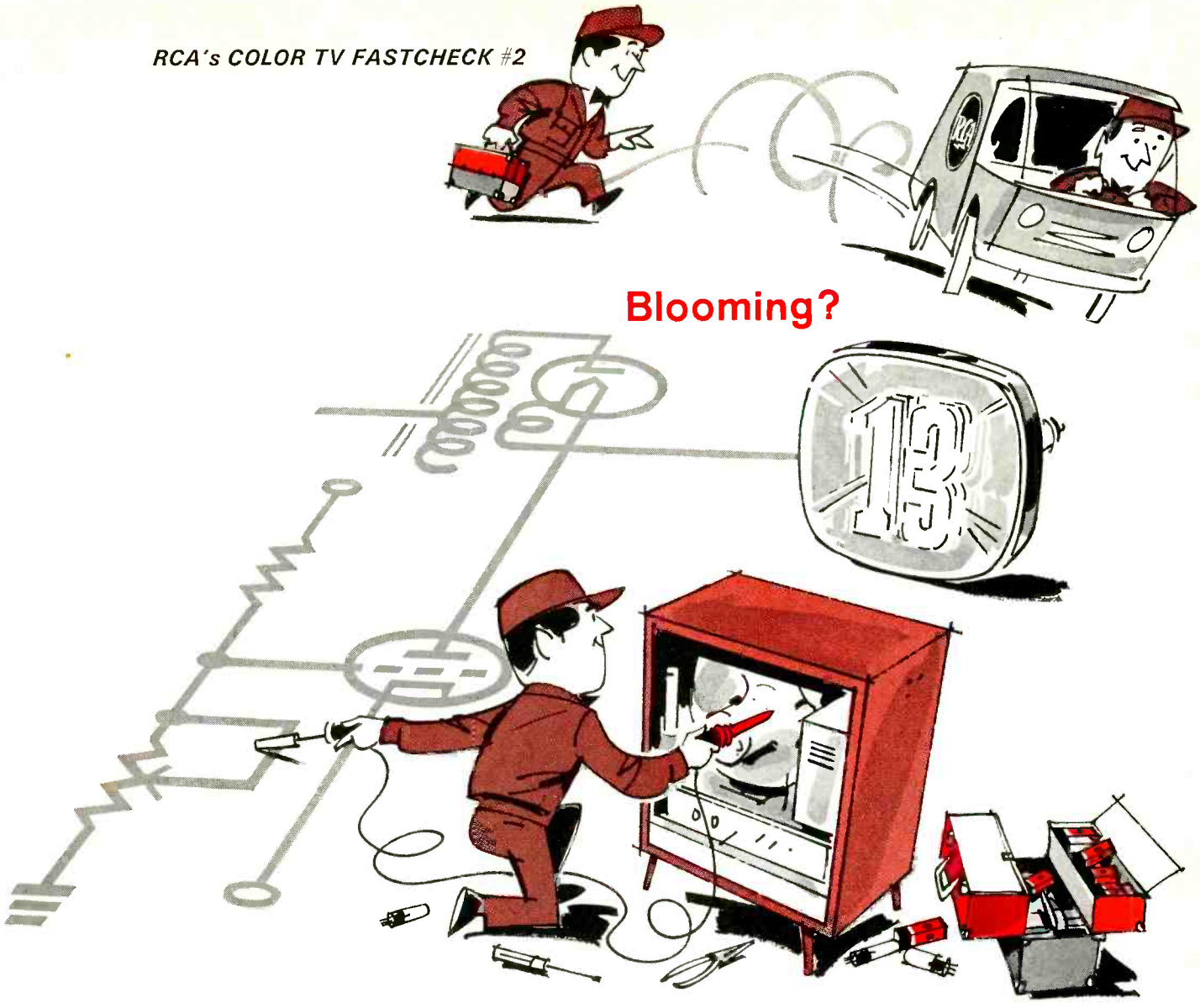
A line of miniature high-voltage power supplies for a variety of applications using special-purpose photo-emissive tubes is announced. The power supplies may be used with ultraviolet and infrared scanning detectors, photometers, and spectrometers, for electro-optical imaging systems, infrared search and tracking systems, and laser systems. The supplies are typically 2.7 x 1 in. and weigh 4oz. ITT.

Capacitors **710**



A line of flattened mylar capacitors designed especially for printed circuits is announced. According to the manufacturer, these capacitors exhibit high insulation resistance, low dissipation factor, low capacitance change, and excellent moisture and life characteristics. The capacitors are available in voltage ratings of 50, 75, 200 and 400vdc for operation up to 125°C. Electro Motive.

RCA's COLOR TV FASTCHECK #2



...Varying picture size? Misconvergence?

Check the high voltage regulator section

Poor high-voltage regulation in color sets can be the cause of many needless call-backs, and in some cases, the outright loss of a valued customer. Merely replacing tubes in the horizontal and high voltage sections could result in a premature tube failure brought about by improper high voltage regulator action. Follow these simple FAST-CHECKS and make your color set servicing life a little easier.

1. Determine the proper value for the high voltage by checking the service notes of the receiver. Measure the high voltage at the picture tube anode connection and adjust the high voltage control for the specified value.
2. Turn the brightness control back and forth. If during this adjustment you get blooming, varying picture size and misconvergence, measure the cathode current of the high voltage regulator tube with the brightness turned down. If the regulator tube cathode current is below the specified minimum when the correct high-voltage is attained, the high-voltage input to the regulator system is probably low.
3. To correct small errors in the high-voltage input to the regulator tube, measure cathode current in the horizontal deflection output tube and adjust the horizontal efficiency coil for the specified current.
4. If this adjustment does not increase the regulator tube cathode current to the specified value, check the horizontal output tube, the damper tube and the drive to the horizontal output tube.
5. After making any adjustments or changes required in step 4, rotate the brightness control. If the shunt regulator tube is in good operating condition and you have made the proper adjustments, the blooming, varying picture size, and misconvergence will disappear.

Before replacing a shunt regulator tube, always follow the procedure above. You'll save time and money and have a satisfied customer.

This color TV service hint is another in a series of service hints from RCA. When you order receiving tubes, always specify "RCA". You'll find your customers better satisfied and you'll have fewer callbacks.

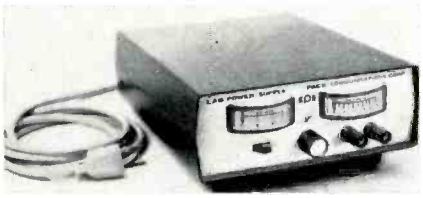
RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

The Most Trusted Name in Electronics

NEW PRODUCTS

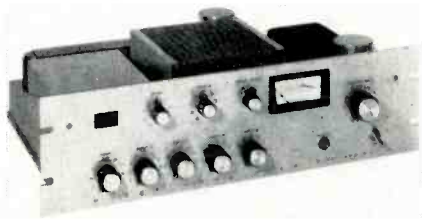
Power Supply 711

A solid-state power unit, designed to supply fully regulated voltages for transistorized equipment, is announced. Unit delivers from zero to 15v at up to 2.5amp for servicing citizens band transceivers, auto radios, transistor radios, industrial laboratory instruments and production line equipment. Pace.



Mixer-Amplifier 712

A solid-state, five-channel, 50w mixer-amplifier is introduced. Model CMA5-50 combines on a single chassis a mixer with five input channels and a 50w power amplifiers. In its rack-mounting configuration it is intended for use in churches, auditoriums, stadiums and other permanent locations. Bozak.



Contact Burnisher 713

A pocket pen-type burnisher-cleaner for the communications, telephone,

electronics industries and all automated plants using relay-actuated equipment. Jonard.

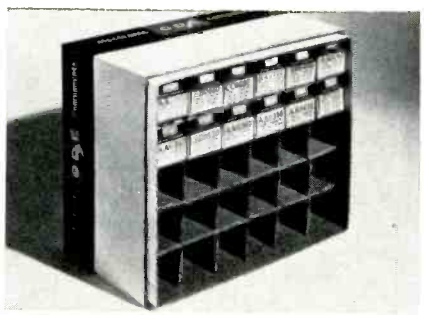
Vibrator Eliminator 714

A solid-state vibrator eliminator is introduced. The unit replaces con-

ventional vibrators in 12v mobile or field pack power supplies. E. F. Johnson.

Capacitor Assortment 715

A twist prong electrolytic capacitor assortment is announced. The capacitors are packaged in a convenient



stock module designed to accommodate a normal working inventory of replacement electrolytics. CDE.

Listen!

Now Jensen brings you 9 auto rear seat speaker kits

They're designed for all popular makes of cars on the road today. New connectors make them faster and easier to install than any other kit.

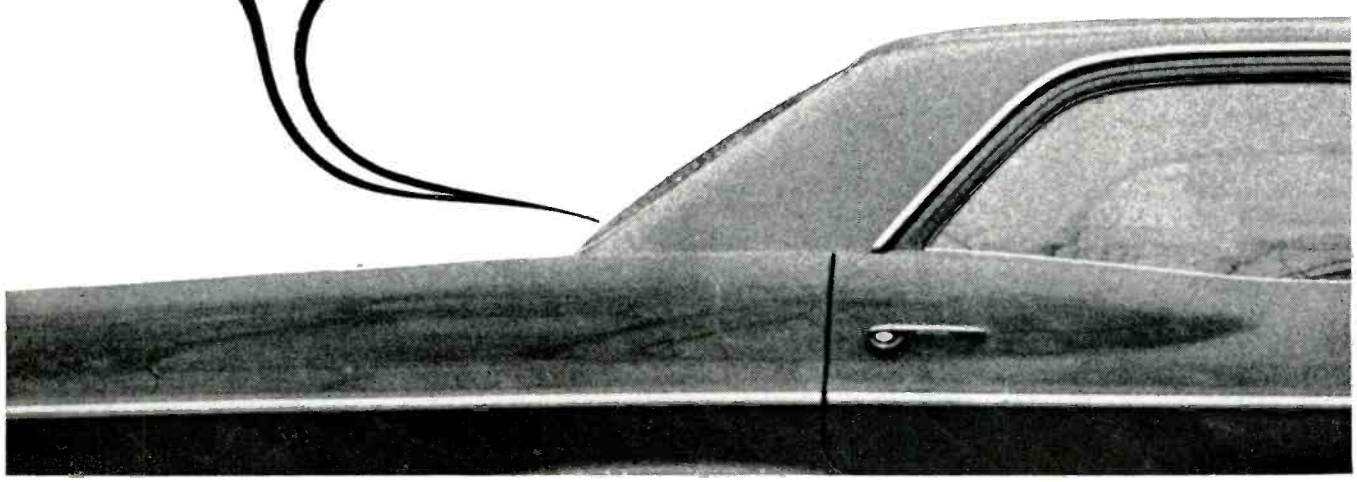
Oversize air gap clearance, dust drain holes, and solid domes eliminate call-backs.

Jensen's nine new models are available in two lines—deluxe and economy. And they're both packaged in Jensen visual Show Pack for display mounting and in standard cartons for off-the-shelf sales.

Don't pass up profits! Ask your Jensen representative for complete details. Or write Jensen Manufacturing Division, The Muter Company, 6601 S. Laramie Ave., Chicago, Ill. 60638

jensen

Over 10 million cars need one here!



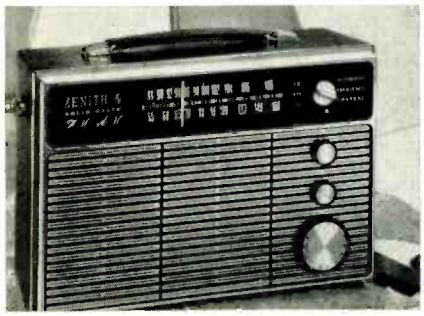
See the new auto rear seat speaker kits and the other new Jensen speakers at the NEW Show in San Francisco.

. . . for more details circle 127 on postcard

NEW PRODUCTS

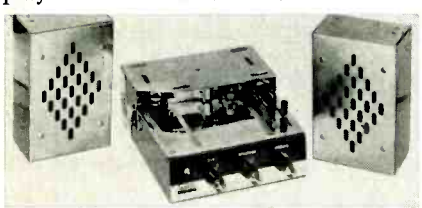
Portable Radio **716**

An 11 transistor, full-size AM/FM portable radio is introduced. It contains an RF stage on FM and is powered by 8 "D" cell batteries. Zenith.



Auto Stereo **717**

A transistorized auto stereo tape player for automobiles is introduced. Designed for all cars, the tape player plays continuous stereo music from prerecorded tapes in plastic, self-contained cartridges. The unit mounts under the dashboard of any automobile. Sentry.



VOM **718**

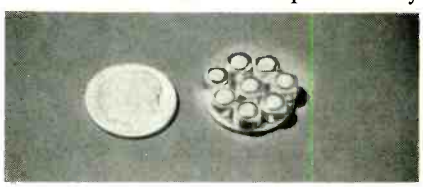
A portable VOM housed in a plastic case with a 6 in. meter is introduced. Specifications are: acv (6 ranges) to 4kv; dcv (8 ranges) to 20kv; dc current (6 ranges); output in db (4 ranges); and 3 resistance ranges. Mercury.

Stereo Tape Recorder **719**

A three-speed stereo tape recorder is introduced. The Continental 420 provides for mixing, monitoring and parallel playback operations. The unit provides up to 16 hrs of playing time in mono and up to eight hrs in stereo from a single seven-inch reel of tape. At 7½ ips, the machine has a frequency response of 40-18,000Hz; at 3¾ ips, of 60-15,000Hz; and at 1⅞ ips, of 60-10,000Hz, all plus or minus 3 db. Norelco.

Hearing Aid **720**

Eight of these all-in-the-ear hearing aids fit on a dime. It is powered by one miniature battery and is invisible when worn inside the ear. Sonotone.



RCA is the Mark of Quality in replacement parts, too

Genuine RCA replacement parts assure the quality performance originally engineered into the equipment...use them to help eliminate costly call-backs

Why settle for substitutes, when genuine RCA precision engineered replacement parts are readily available? They're specifically designed and matched for optimum performance in RCA equipment. Many RCA parts also have universal application (wherever used, they assure RCA's high standard of quality). Your RCA Distributor stocks them for all your parts requirements, including those for:

- ...Color TV, Black and White TV, Radios, Hi-Fi's, and other Home Instruments
- ...RCA Audio-Visual equipment for schools, business and industry
- ...RCA Broadcast equipment for radio and TV stations
- ...RCA Radiomarine equipment
- ...RCA Microwave systems for local utility, turnpike, and other right-of-way communications
- ...RCA 2-Way Radio equipment for police, fire departments, taxicab and truck fleets
- ...RCA Servicemen's Test Equipment.

Avoid wasting profitable service time trying to make-do with substitutes. Your RCA Distributor can supply you with all the genuine RCA replacement parts you need, competitively priced—and readily available.

RCA PARTS & ACCESSORIES, DEPTFORD, NEW JERSEY

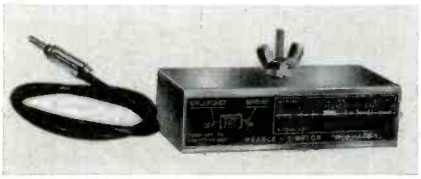
Get comprehensive literature—cross-reference and application data on replacement parts—available from your RCA Distributor.

The Most Trusted Name in Electronics

NEW PRODUCTS

Converter 721

This unit converts an ordinary domestic or foreign car radio into a



marine band receiver. It measures 4½ x 1 x 2½ in. and weighs 6 oz. It is self-contained with its own built-in power supply and solid-state circuitry. Pearce-Simpson.

Soldering Iron 722

A desoldering unit with a portable squeeze bulb vacuum source is announced. A choice of two types of

rubber squeeze bulbs is offered: soft and firm. Replaceable tips come in a wide variety of sizes and types including eighteen different IDs and ODs in four different types of material. Air-Vac.

Coaxial Cable 723

A low-loss cable designed for home TV reception on all-channel color sets is introduced. The cable causes about

half as much loss as ordinary RG59/U coax, the manufacturer says. It is packaged in handy lengths, with coaxial fittings and a weatherboost attached. Jerrold.

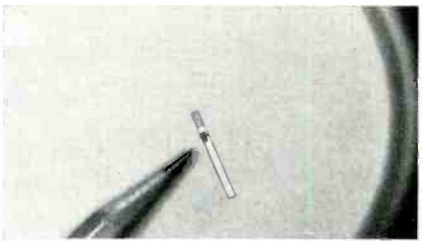
Two-Way FM Radio 724

A desk mounted two-way FM radio for base to base or base to mobile

communications is announced. The unit has a power rating of 20-25w and operates at from 450-480MHz (UHF). Comco.

Phono Cartridges 725

A line of semi-conductor transducer cartridges is announced. The solid-



state cartridges are available in three different versions: standard stereo, miniature stereo and standard mono. Sonotone.

10 facts you should know about color-bar generators

If you are going to buy a color-bar generator *—or even if you already own one*—here are several facts you should know.

While other types of test instruments may lack one or more features, they may still be useful in skilled hands—*provided* the user is aware of their shortcomings and *provided* he has other means of determining what he must know.

This is not true of a color-bar generator.

A color-bar generator should allow you to walk away from an adjusted receiver knowing that the owner can turn it on and receive color broadcasts in full-fidelity color and sound.

Not all color-bar generators can give you this assurance.

Let's talk facts.

FACT NO. 1: ***A gated-rainbow type generator is accepted as the standard of the service industry***

You do not need fully saturated NTSC colors to achieve perfect adjustment any more than you need an FCC-type broadcast signal for tuner and if-amplifier alignment. The gated-rainbow type signals are used by virtually all TV manufacturers in establishing service procedures for their sets.

Gated rainbow color-bar pattern

Urgent service needs for a trustworthy color-signal source were met years ago when RCA introduced the *gated-rainbow* system.

Today, this basic system is used in nearly all service-type color-bar generators. The waveforms and procedures in nearly all color-TV service notes are based on this system.

FACT NO. 2: ***All gated-rainbow type generators are not alike***

In spite of their basic circuit similarities, available models differ in their features, accuracy, and ultimate usefulness. Some of these differences are critical.

FACT NO. 3: ***The offset subcarrier oscillator must be controlled within a few cycles of its true frequency***

This oscillator controls the phase angles (hues) of the color-bar pattern. It is the *heart* of the color-bar generator.

The subcarrier oscillator should be within ±20 cps of its fundamental frequency of 3.563795 megacycles. *In the crystal-controlled RCA WR-64B Color-Bar / Dot / Crosshatch Generator, this deviation is kept well within the ±20 cps limit.*

FACT NO. 4: ***Provision must be included to prevent the subcarrier oscillator from drifting off frequency***

The subcarrier oscillator must not only be accurate when the instrument is *new*—it must *stay* accurate. Top-quality components minimize undesirable frequency changes.

Check, for instance, the trimmer capacitor used in the 3.56-Mc subcarrier oscillator. *You'll find a piston-type ceramic capacitor—not a flat mica type—in the RCA WR-64B.*

FACT NO. 5: ***The generator must have an rf-sound carrier to assure proper setting of the fine-tuning control***

Unless your color-bar generator has this essential feature, it may produce a perfect color-bar pattern on the receiver, *but at the wrong setting of the receiver fine-tuning control. In such cases, the receiver may not correctly reproduce a color program.*

The WR-64B has this necessary feature. With it, you can accurately set the fine-tuning control *before* making color adjustments. *In the WR-64B the rf-sound carrier is also crystal-controlled.*

FACT NO. 6: ***The rf picture carrier must be exactly on frequency to assure that the color subcarrier is correctly placed in the receiver bandpass***

Drift, faulty adjustment, or aging of components in the rf oscillator section can move the generator picture carrier off frequency. This shift, in turn, will also move the color subcarrier signal away from its correct position in the receiver bandpass. In some receivers, this shift will affect accuracy of color-circuit adjustments.

A separate crystal-controlled oscillator is used in the WR-64B to keep the picture exactly on frequency.

FACT NO. 7: ***The axes of the output color-bar pulses should lie on the zero axis—and not on elevated brightness pedestals***

Elevated pulses necessitate use of an oscilloscope for accurate setting of receiver phasing. A generator having zero-axis color-bar pulses, such as the WR-64B, does not require use of an oscilloscope for checking phasing in the customer's home.

FACT NO. 8: ***The generator should not require frequent adjustment of internal counter circuits***

All color-bar generators contain circuits which develop vertical and horizontal sync, and dot-and-bar-pattern signals, by dividing or counting down from a higher frequency: usually 189 Kc. If one of these circuits is unstable, the patterns can jitter, ripple, jump sync or contain the wrong number of dots or bars.

Conventional R-C circuits are used in the counters of most generators. *But the RCA WR-64B uses inherently stable iron-core inductors in its counters,* thereby assuring long-term counter-circuit stability.

FACT NO. 9: ***The proper way to check receiver color performance is to feed the generator signal into the antenna terminals***

Color performance depends on overall receiver condition—not on that of a single section alone. A color-test signal fed directly into the video amplifier—rather than through the antenna terminals—will not provide a proper check of the complete receiver. *The only method you should use in adjusting the receiver, therefore, is the rf-signal-input method*—the method provided by the RCA WR-64B.

FACT NO. 10: ***There is no "best" dot size or bar width for convergence adjustments***

Generator dot size or bar width has no significance for convergence adjustments.

Veteran technicians, however, have found that very small dots or thin bars are difficult to use under average lighting conditions. If receiver brightness is turned up to overcome this handicap, blooming will result. Proper convergence cannot be achieved under this abnormal condition.

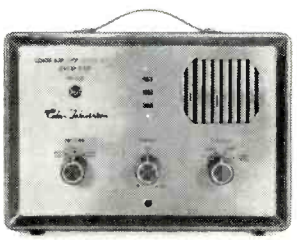
The dot and bar size of the WR-64B is small enough to permit exact, speedy adjustment, and large enough to be useful under average lighting conditions.

These are ten specific facts you should know about color-bar generators. They add up to this

FACT: ***The new RCA WR-64B has all the features you need for complete color-circuit adjustment***

It's the *one* color-bar generator that meets all servicing requirements—from the company that pioneered and developed the color-TV system now in universal use: RCA!

Order it today from your local Authorized RCA Test Equipment Distributor.



$189.50* *Optional distributor resale price. May be slightly higher in Alaska, Hawaii and the West. Prices subject to change without notice.

RCA ELECTRONIC COMPONENTS AND DEVICES,
HARRISON, NEW JERSEY

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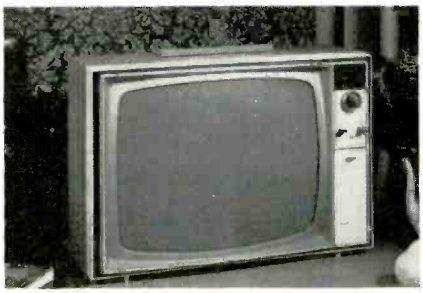
NEW PRODUCTS

Portable TV **726**

A series of 21in. black and white portable television sets which feature



a solid-state signal system, plus a power transformer is introduced. Philco.

Voltage Booster **727**

A heavy duty voltage booster is announced. The line voltage can be

increased in two steps, the first gives a 10% voltage boost and the second gives a 15% boost. The unit has a 1500w capacity. Terado.

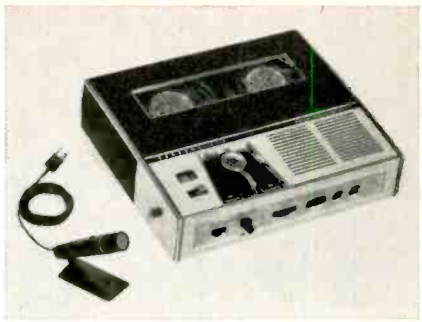
Electrical Display **728**

More than 243 packaged items are available in this display, including

fuses, switches, plugs, wall plates, outlets, push buttons, extension, appliance and replacement cords, utility lights and wire. ITT.

Tape Recorder **729**

A solid-state recording instrument which permits recording in both forward and reverse directions by a turn of a single lever is introduced. By eliminating reel-changing, the tape recorder doubles continuous recording and playback time, to three hours or more on a single standard reel of tape. Concord.

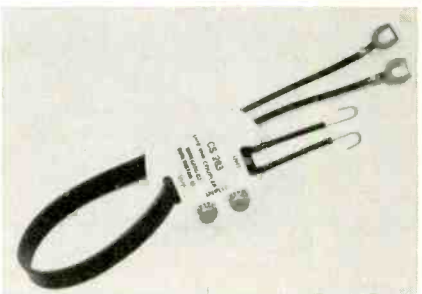


Contour Chair **730**

An industrial contour chair with a fiberglass shell and swivel base is introduced. The chairs are available in 28 to 32 to 36 in. working heights with 4 in. vertical adjustment. Sandefur.

Signal Splitter **731**

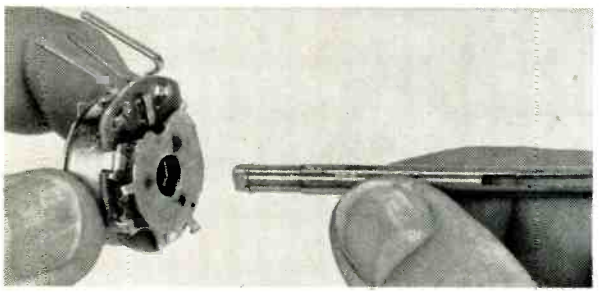
A UHF-VHF back-of-set signal splitter is introduced. The model CS283 incorporates a printed circuit. Use of a printed circuit provides more



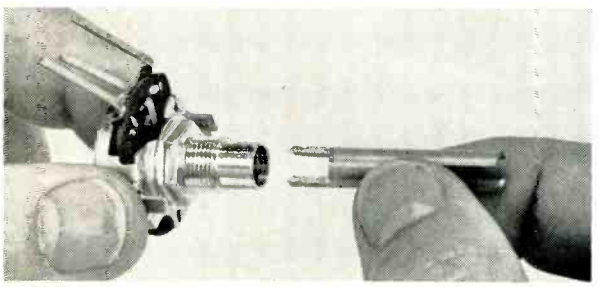
efficient performance, minimum circuit loss, maximum efficiency and performance and eliminates capacitance between coils, the manufacturer says. Winegard.

MALLORY Tips for Technicians

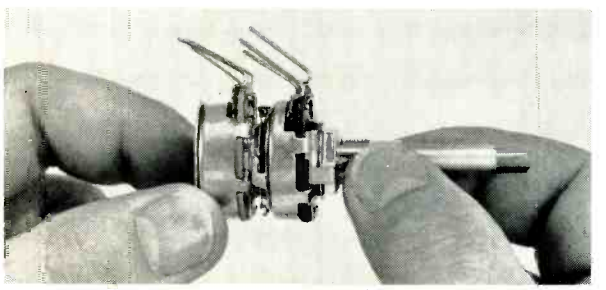
Short-cuts in custom-building controls



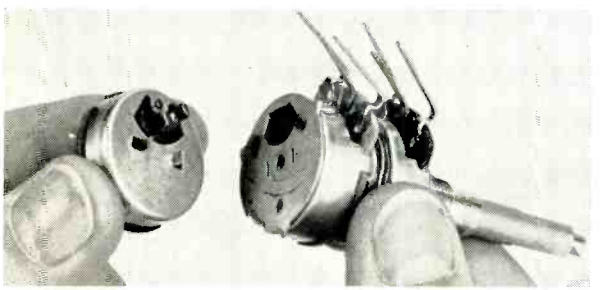
1. Snap shaft into rear section



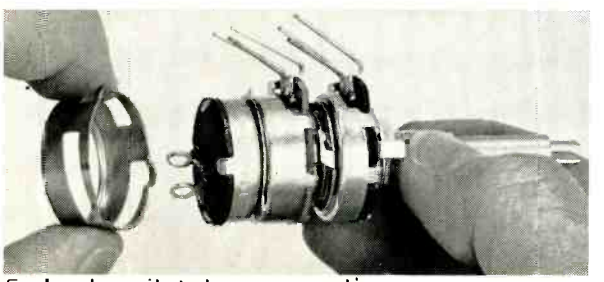
2. Snap shaft into front section



3. Twist-lock sections together



4. Insert switch



5. Lock switch to rear section

Sometimes it seems as though there's some sort of conspiracy to keep you from getting the exact control you need. For example, some of the new television and auto radio sets have really *wild* combinations of control elements, shafts and switches. And, every once in a while one of these fancy dudes just up and quits.

What do you do now? Hunt all over the town for the exact replacement? Or, maybe you'd like to convince the customer's kids to just stare at that blank tube for a few weeks while you try to order the control from the factory. Well, cheer up. There's a better way!

Just zip down to your Mallory Distributor and explain your problem. He'll turn to his STA-LOC® Control Center and come up with your particular control in three minutes flat. No foolin'! He's got the parts to make any of nearly *FIVE BILLION* different controls. How about *that*, control fans!

But if you think STA-LOC is just for replacement controls, you are wrong. Matter of fact, with just a little imagination, you can dream up a control that would make a graduate engineer turn green with envy. All you do is turn to pages 30, 31 & 32 in the 1966 Mallory General Catalog. You'll find carbon front sections from 100 ohms to 10 megs. You can couple these to all sorts of rear sections. And then add a switch. And then . . . WOW! . . . get a load of all those wild shafts! Maybe you'd like to make a "clutch" control so that both front and rear turn together except for balancing. It's a *snap* with STA-LOC.

STA-LOC controls snap together and *stay* together. Even the shafts just plug in. Everything fits and works smoothly. There's even a special single control series called the "UA" . . . a real timesaver.

If you have really exotic tastes, you can take any rear section and make it into a single control by just snapping on an adapter bushing. Then, you plug in a shaft or, maybe add a switch.

Before you get the idea that STA-LOC is absolutely perfect, we'd like to set the record straight. Every once in a while a set manufacturer comes up with a design problem that can only be solved by an all-in-one-chunk control. Some of these weird designs just *can't* be made up from STA-LOC parts. So, after Mallory has made a few thousand of these "far-out" dudes, we stock some. Then, we can shoot 'em to your Mallory Distributor if and when you ever need one. The whole point of this statement is to let you know that your Mallory Distributor *has*, (or can get), just about any doggone control you'll ever need.

Next time you're talking to your Mallory Distributor, ask him about a STA-LOC Technician Kit. With one of these kits you can make replacements *on the spot*, or experiment to your heart's content. For the name of the distributor nearest *you*, write to Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Box 1558, Indianapolis, Indiana 46206.

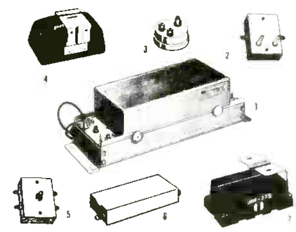
50th ANNIVERSARY

. . . for more details cicle 134 on postcard

. . . for more details circle 135 on postcard

NEW PRODUCTS

UHF-TV Distribution **732**

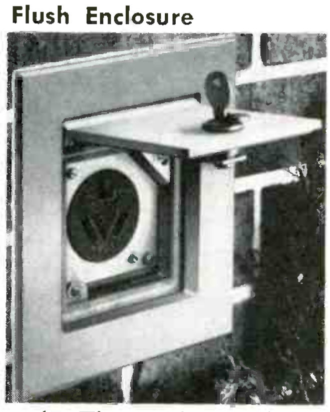


The system is built around a solid-state UHF distribution amplifier and solid-state line extenders which will drive an unlimited number of UHF sets which can be used for demonstration of UHF sets in dealer showrooms and display floors. If the dealer already has a VHF distribution system, this system can be installed parallel to it without disturbing the VHF set-up. Winegard.

Radiotelephone **733**

A solid-state, HF, single sideband transciever is announced. The unit, which uses tubes only in the final and driver stages of the transmitter, has a frequency range of 1.6 to 15MHz. Six channels are available in this band and may be intermixed for both duplex or simplex operation. Power output is 100w with capability of operation on single sideband suppressed carrier or compatible AM to work in with existing systems, plus CW telegraph. Transmitter is monitored by automatic load control and the receiver by automatic gain control. KAAR.

Flush Enclosure **734**



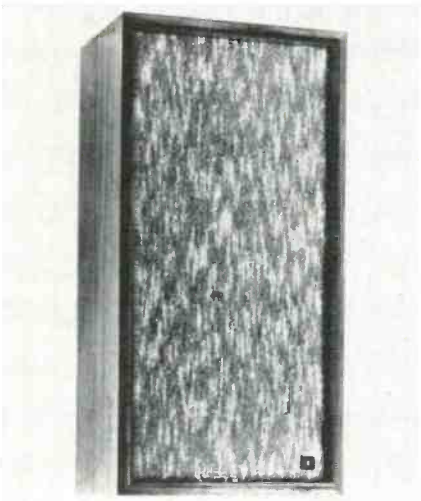
A specification grade weatherproof assembly with locking cover that may be used with either switches or outlets is announced. This assembly is installed flush with the wall and cannot be pried open. It is recommended for schools, plants, commercial and institutional buildings, freight yards, public housing, mobile home communities and parks. The weatherproof assembly can be used with outlets up to 50amp rating and 15, 20 and 30amp switches. Pass & Seymour.

Cable Stripper **735**

A cable stripper for the professional electrician, telephone technician, or home handy-man is introduced. Shoe attached to base of cutting blade, inserts under insulation to protect conductors while blade is guided along cable. Top edge becomes handy blade for stripping insulation from wires, when tool is flipped over. Specialty Development.

Speaker 736

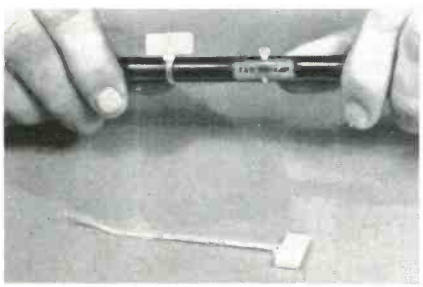
An air suspension speaker system, rated at 8Ω is introduced. The S8 is designed for use with solid-state amplifiers. According to the manufac-



turer the speakers are designed for nearly constant impedance throughout their entire frequency ranges. Scott.

Marker Plates 737

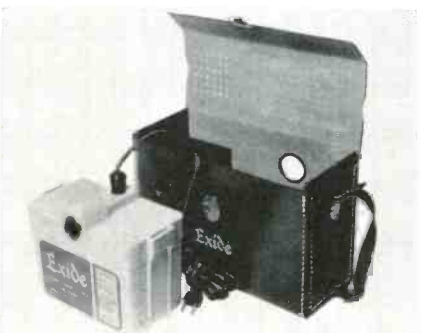
A line of marker plates designed for small wire bundles, single coax and small diameter conduit identification



is introduced. The plates combine marking area and nylon tying strap in one integral unit. T&B.

Power Pack 738

A power pack for portable TV, tools and appliances is introduced.



The pack incorporates a sealed lead-acid battery and an automatic charger in a carrying case with adjustable shoulder strap. Total weight of the power pack is only ten lbs. Dimensions of the vinyl-coated carrying case are 9¾ x 6½ x 3¾ in. Exide.

RAPID-FIRE . . .

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power supply filter sections and watch for self-induced oscillations in some stages.

Some Final Hints

"Here are a few hints I'd like to pass along to other technicians. First, for locating intermittent troubles in a stereo amplifier or any other electronic gear. The amplifier volume, for example, may go up and down intermittently or go completely out and yet may run good for hours before acting up at all. Inject a squarewave into the suspected channel and connect both scope probes into different sections of the amplifier. When the volume fluctuates just glance at the scope and note any changes in the waveshapes. If no change in the pattern, move the probes to different stages. With this system you can isolate the defective stage rapidly.

"Another thing," Bob continued, "when you interpret the signal on the scope, don't always expect to obtain a perfect squarewave from the stereo amplifier that is functioning properly. You'll have to consider the design and quality of the amplifier being checked. Check the service data specifications as to the amplifier's frequency response and quality of the components. In some lower-cost amplifiers you'll notice an overshoot, or rounded waveshape, caused by slow risetime which indicates poor high-frequency response. Some of the lower-cost amplifiers have a risetime of 6 to 10μsec/cm. But after a little experience with different amplifiers you'll know what to expect and with this system you'll have a correct waveshape to compare it with.

"Let's take one more look. (Fig. 6). Note the dual traces. We get this effect by adjusting the tone controls of both amplifiers. The top trace shows one channel control set for base and the bottom trace shows the other channel control set in the treble position. This gives a brilliant response.

"One final point. It is generally wise to disconnect the speakers when checking amplifiers and load the amplifier with the proper resistor—makes it easier on the ears. Since the voice coil is inductive and not purely resistive, this will have some slight effect on the squarewave response."

Bob Goodman says he's doing research on advanced servicing techniques using the triggered scope and squarewave generator. He's concentrating on RC multicomponent networks and microelectronic circuitry. ■

CATALOGS AND BULLETINS

Music Systems **400**
This brochure describes a line of music systems. Specifications for a number of FM/stereo receivers, tuners and amplifiers are also included. Harman Kardon.

Lamp Ballasts **401**
This 12-page bulletin describes a line of constant wattage mercury vapor ballasts. Specifications, charts and technical data are included. Sola.

Soldering Irons **402**
Dimensions and specifications for a line of soldering tools are included in this brochure. Cartridges, tips and handles are described. Ungar.

Soldering Tips **403**
A 28-page catalog shows all types, sizes and shapes of soldering tips. Many actual size illustrations are included. American Beauty.

Nutdriver Set **404**
This bulletin describes a hip pocket size nutdriver-screwdriver set. Xcelite.

Power Tools **405**
This 32-page catalog contains prices and specifications for a line of power tools and accessories. Drills, sanders and saws are among the tools listed. Skil.

Electronic Test Accessories **406**
Molded patch cords, cable assemblies, molded banana plugs, molded test leads and many other accessories are listed in a 32-page catalog. Pomona.

Precision Tools **407**
This brochure contains specifications of tools used for telephone relays, central office equipment, precision instruments and business machines. Jonard.

Frequency Meters **408**
Specifications, outline and mounting dimensions for a line of frequency meters are given in this bulletin. Airpax.

Electrolytic Manual **409**
This 64-page electrolytic manual lists original part numbers for each manufacturer, followed by ratings and recommended replacement. Capacitor replacements for TV sets, transistor and auto radios and tape recorders are included. Sprague.

Microphone **410**
This brochure describes a unidirectional dynamic lavalier microphone. Specifications and dimensions are given. Shure.

Controls **411**
A 4-page brochure describes "snap together" controls which fill 95 percent of replacement requirements. Clarostat.

Connectors **412**
A 28-page catalog gives specifications of a line of RF connectors and coaxial cable. Amphenol.

Chimney Mounts **413**
This leaflet describes a line of chimney mounts for TV antenna installation. List prices are also included. Parker.

Semiconductors **414**
A 16-page catalog lists semiconductor replacements for different functions in TV sets. A number of TV manufacturers are covered. A transistor replacement guide is also included. G-E.

Digital Voltmeter **415**
This 2-page technical data sheet describes a solid state dc digital voltmeter. Ballantine.

DIODES . . .

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for converting dc to ac and in many other power control applications.

Tunnel Diodes

The tunnel diode is the most startling and spectacular component having negative resistance characteristics. Because it works on a different semiconductor principle, called *tunneling,* it is useful from dc to the gigahertz region. Tunneling is a special case of the same kind of conduction that takes place in a copper wire. As a result an electrical impulse propagates through it with the speed of light—and with no waiting for carriers to cross the junction.

A typical tunnel diode voltage-current curve is shown in Fig. 7. Note that voltage lies along the X axis, a change from the previous EI curves. (This is one source of the confusion surrounding negative resistance. By changing the unit represented along the two axes both types of negative resistance curves have the same shape.) The three load lines drawn with this curve represent the three possible modes of operation: the tunnel diode is so simple its function is determined by its biasing.

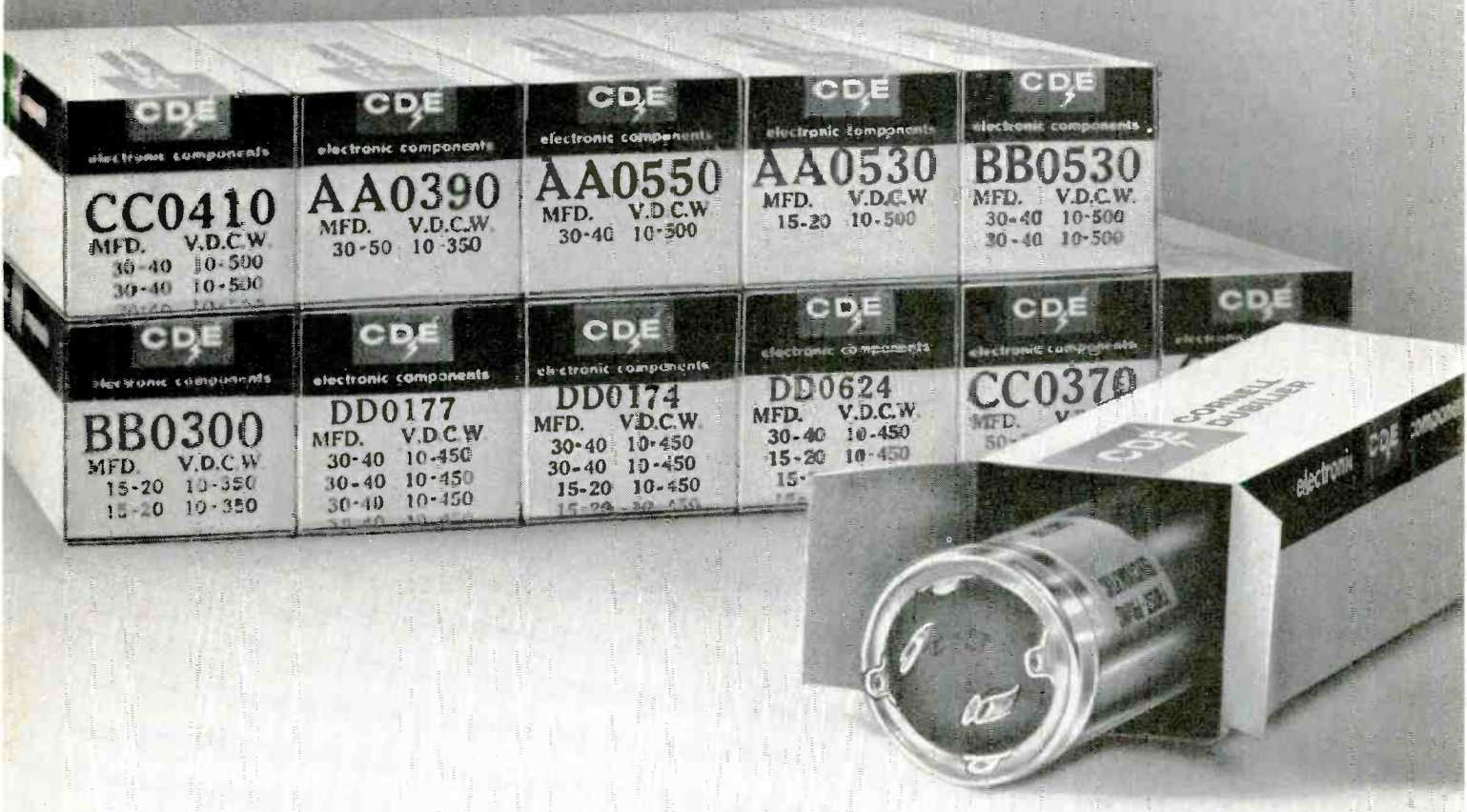
Operation with this type of negative resistance usually involves supplying the components with a constant current source then switching it into its high resistance state and letting the difference current flow through the load. The equivalent circuit for most tunnel diode circuits is shown in Fig. 8. The inductor is the element that gives constant current operation since it will not permit rapid changes in current.

When E and R are selected to give load line 2 (Fig. 7), the circuit stabilizes at point "A." When a current pulse is applied at the input the current through the tunnel diode increases to point "P" then switches to its high resistance mode. Since the current through the circuit can't change instantly, because of the inductance, operation switches to point "B" as shown by the dashed line. Then the current decays from "B" to "C" and operation switches to point "D" and then builds up to the stable point "A," the starting place. This is the tunnel diode operating as a one-shot multivibrator.

Flip-flop operation occurs when "E" and "R" are selected for load line 1. The inductance is made zero. Now a current pulse switches operation to point "E," another stable point. A negative current pulse is required to reset this circuit to point "A."

Load line 3 represents a stable point in the negative resistance region. With a tunnel diode, it is very difficult to obtain this operation in practice. Because the tunnel diode shows the negative resistance characteristic up to very high frequencies it is hard to get the stray inductance of the connections low enough — a condition for stability in this region. Assuming inductance in the circuit, the following operation takes place. When the power is turned on, the current starts to rise, heading for the load line. At point "P," the tunnel diode switches to the high resistance region and the op-

The Magnificent 12



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CDE CORNELL-DUBILIER

erating point switches to point "B." The inductance then discharges to point "C," the diode switches to point "D" and the whole process starts over. *This is operation as a free running multivibrator.*

To use the negative resistance of a tunnel diode in a linear circuit—as an amplifier, oscillator, or Q multiplier—it is necessary to operate on load line 3. This requires special techniques for coupling to the component and great care to stabilize it.

Most often, it is mounted as part of a transmission line or waveguide. Used this way, it makes a very simple, rugged, and flexible RF preamplifier that can be operated detached from the main receiver. As an oscillator it will cover an amazing bandwidth with no adjustment since no feedback loop exists to be affected by changes in the active element.

Some of these problems of routine use of this type of negative resistance characteristic are overcome by packaged negative resistance elements. These units do not use components with intrinsic negative resistance characteristics. They are packaged transistor circuits with feedback to obtain the desired characteristics. Their convenience, stability, and usefulness justify including them with the other new negative resistance components. Because they are transistors, their frequency response is not as high as the tunnel diode and stabilizing them is no problem. They operate in the same manner, for the various uses, as outlined for the tunnel diode.

Whatever the source or type of negative resistance, circuits operating with these new components represent an improvement. They are smaller, simpler, cheaper and more reliable. This is more proof of progress in modern electronics. ■

The SK-3009 transistor that came in this box replaced one transistor in original equipment. But, it could just as easily have replaced almost 600 different transistors. RCA has 16 such replacement transistors plus 2 replacement rectifiers comprising the SK Top-of-the-Line series. If you stock all 18, you can replace more than 4,000 transistors, both domestic and foreign types, and over 1,000 selenium or silicon rectifiers. Stock the Top-of-the-Line series. The time that you will save in looking for replacements alone is well worth the investment.

RCA's new Top-of-the-Line Replacement Guide SPG-202A is an absolute necessity if you are servicing solid-state entertainment-type equipment. It lists the 18 RCA types and the more than 5,000 types which they replace. Ask your RCA Distributor for your copy or write: Commercial Engineering, Section E 46SD RCA Electronic Components and Devices, Harrison, New Jersey.

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ADVERTISERS INDEX

Winegard's original BC-208 4-set Booster Coupler is now available in a 75-ohm model; the BC-475.

Producing a 75-ohm, 4-set booster coupler as good as the BC-208 wasn't easy. After all, the BC-208 was the first 300-ohm, 4-set booster coupler made. And it's still the best. It still out-performs and outsells anything like it on the market!

And so will the new BC-475!

Here's why: the new BC-475 is actually two products in one. It's a small system amplifier that will drive 2 to 8 sets for homes, apartments and store displays. And it's an amplified line splitter and extender for adding up to 16 trunk lines in large master antenna systems.

More reasons? The new BC-475 is coax; it provides a 6db gain to each of four outputs instead of the usual 6db loss (for an overall gain of 12db per output); it takes up to 400,000 microvolts of signal input (200,000 per band) without cross modulation: and it provides exceptionally high isolation to eliminate interaction between sets.

Sound expensive? How does only $34.95 list sound for the best 75-ohm 4-set booster coupler made? A booster coupler that drastically reduces snow, picture smear, noise and interaction between TV sets (color and black & white). And does wonders for FM sets, too.

Better call your Winegard distributor or write for Fact Finder WBC-475 today!

Winegard antenna systems

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